

# **THE BALLISTIC MISSILE DEFENSE ORGANIZATION**

**Presents:**

## **A Program Briefing for Industry and Government (PBIG)**

**Unclassified Proceeding**



19980302 062

April 9-10, 1996

United States Department of State

Washington, DC

Event #614

**BMDOTIC DTIC QUALITY INSPECTED 4**

**DISTRIBUTION STATEMENT A**

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U6058



Abstract: Unclassified Proceedings  
Accession Number: 6058  
Cataloged Date: Jul 30, 1996  
Number of Copies in Library: 000001  
Copyrighted or Not: N  
Corporate Author or Publisher: BMDO, The Pentagon, Washington, DC  
20301  
Descriptors, Keywords: Briefing Industry Government PBIG  
Unclassified Proceedings  
Pages: 296  
Publication Date: Apr 09, 1996  
Record ID: 41729  
Title: Ballistic Missile Defense  
Organization: A Program Briefing for  
Industry and Government (PBIG)  
Unclassified Proceedings  
Document Type: HC



# Ballistic Missile Defense Organization (BMDO) Program Briefing for Industry and Government Unclassified Proceedings

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(Research, Development, and Acquisition)

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# Ballistic Missile Defense



6 MAR 96 + April PBIG

**Dr. Paul G. Kaminski**  
**Under Secretary Of Defense For Acquisition And Technology**





# MEETING THE BALLISTIC MISSILE THREAT

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	To Theater	To United States
Prevent / Reduce Threat	Non-proliferation Treaty, North Korea Framework Agreement, INF Treaty, MTCR, Export Controls	START I, START II, Cooperative Threat Reduction (Nunn - Lugar)
Deter Threat	Counterproliferation, Theater Nuclear Forces	Strategic Nuclear Forces
Defend Against Threat	TMD Lower Tier TMD Upper Tier	NMD





# BALLISTIC MISSILE THREATS

---

## *Theater*

- Short Range
  - Here And Now
  - Many Missiles In Many Countries
- Medium Range
  - Emerging
- Chemical, Biological Threat Now  
Nuclear Possible In The Future

## *Strategic*

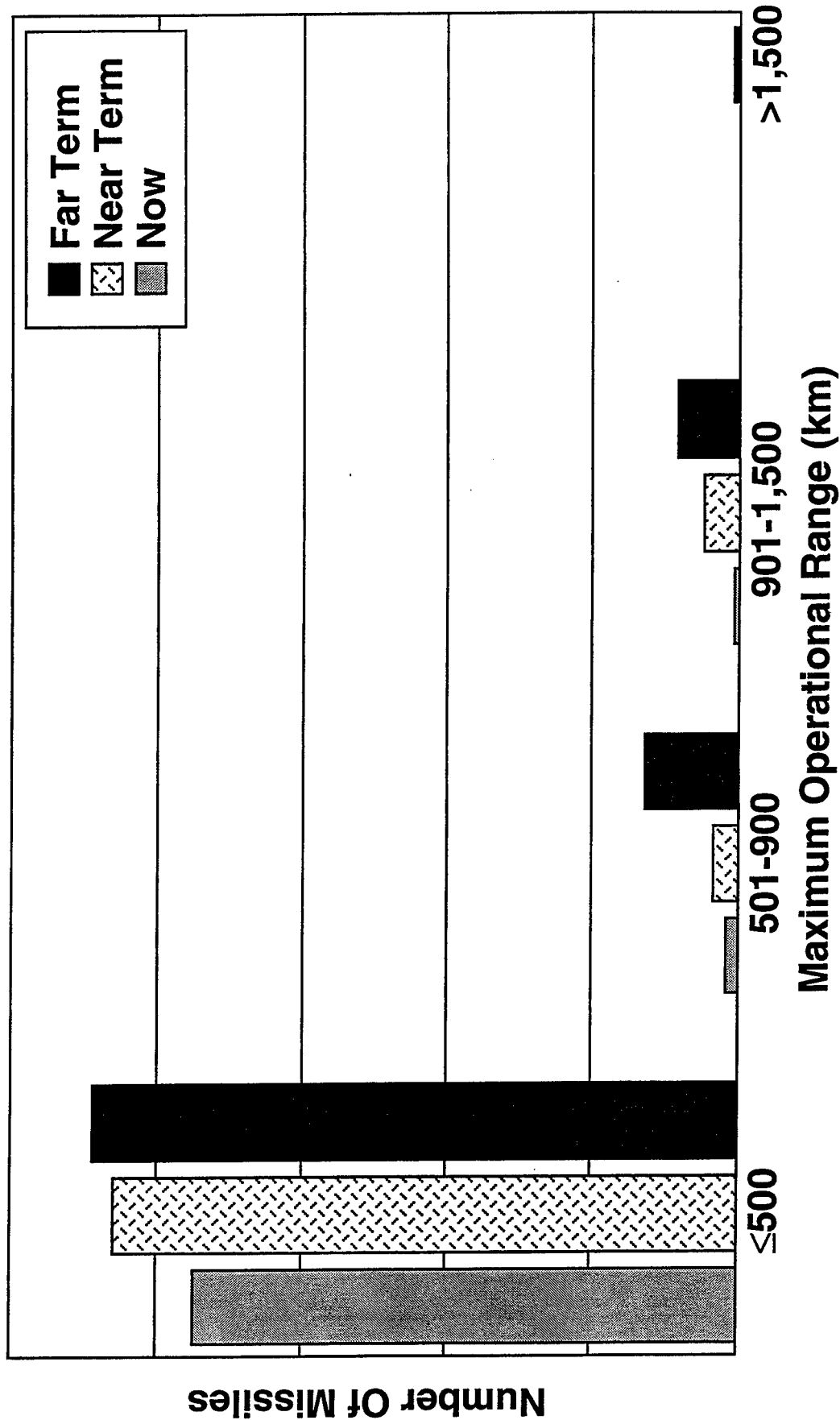
- Russia / China Face Significant U.S.  
Deterrent
- Threat From Rogue Nations Not Expected  
Soon But Could Emerge In The Future





# TBM FORCE PROJECTIONS

## Potentially Hostile Countries







# **BALLISTIC MISSILE DEFENSE PRIORITIES**

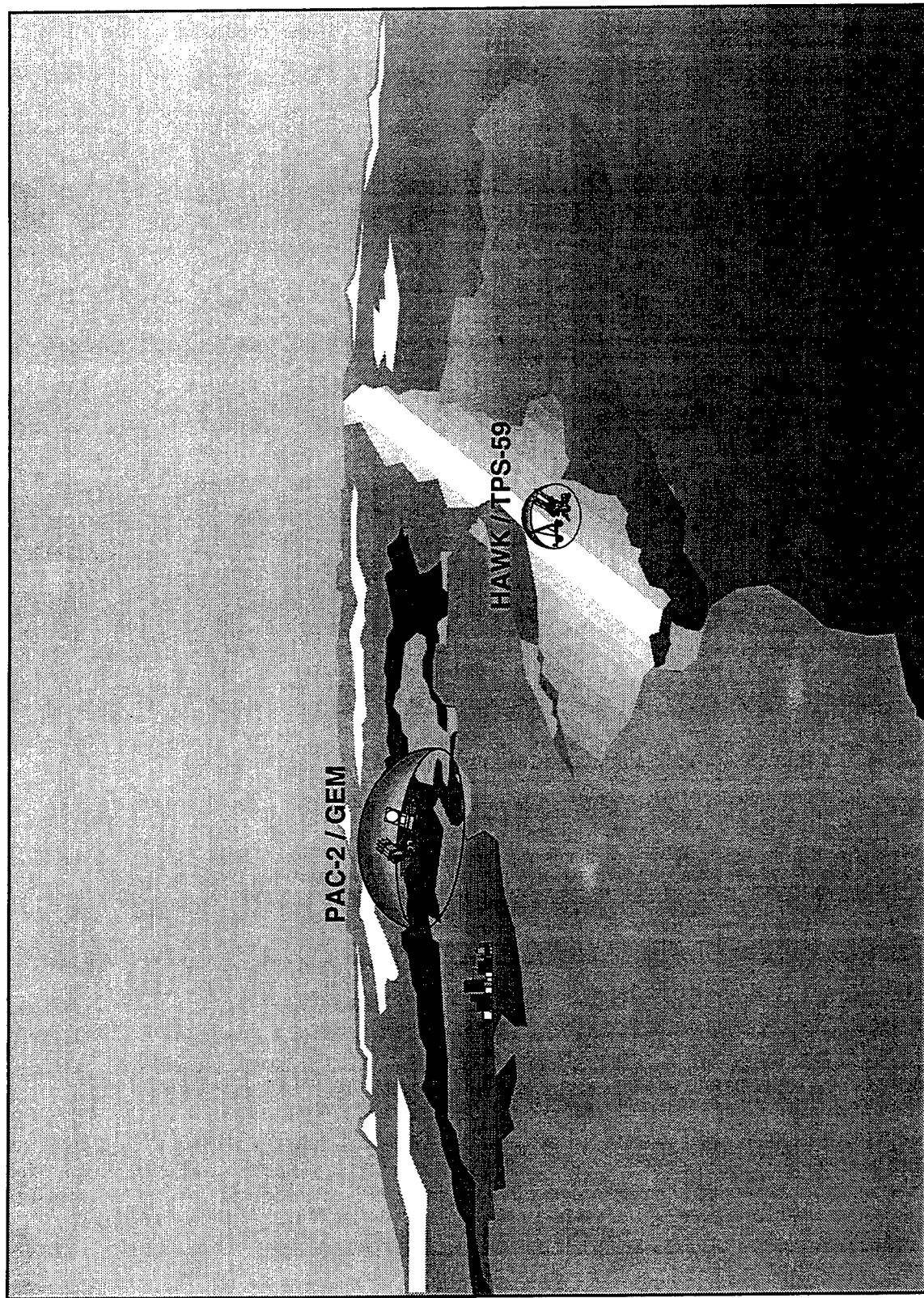
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- **We Have Not Altered Our BMD Priorities**
  1. **Defend Against Theater Ballistic Missiles And Cruise Missiles**
    - **Short-to-medium-range Missiles In Theater -- Theater Missile Defense Lower Tier**
    - **Area Defense And Longer-range Theater Missiles -- Theater Missile Defense Upper Tier**
  2. **Develop Capability To Defend Against ICBMs Threatening The United States -- National Missile Defense**
  3. **Develop Technology To Hedge Against The Future Threat -- Technology Base**
  
- **We Are Increasing Our Emphasis On Responses To The Cruise Missile Threat**





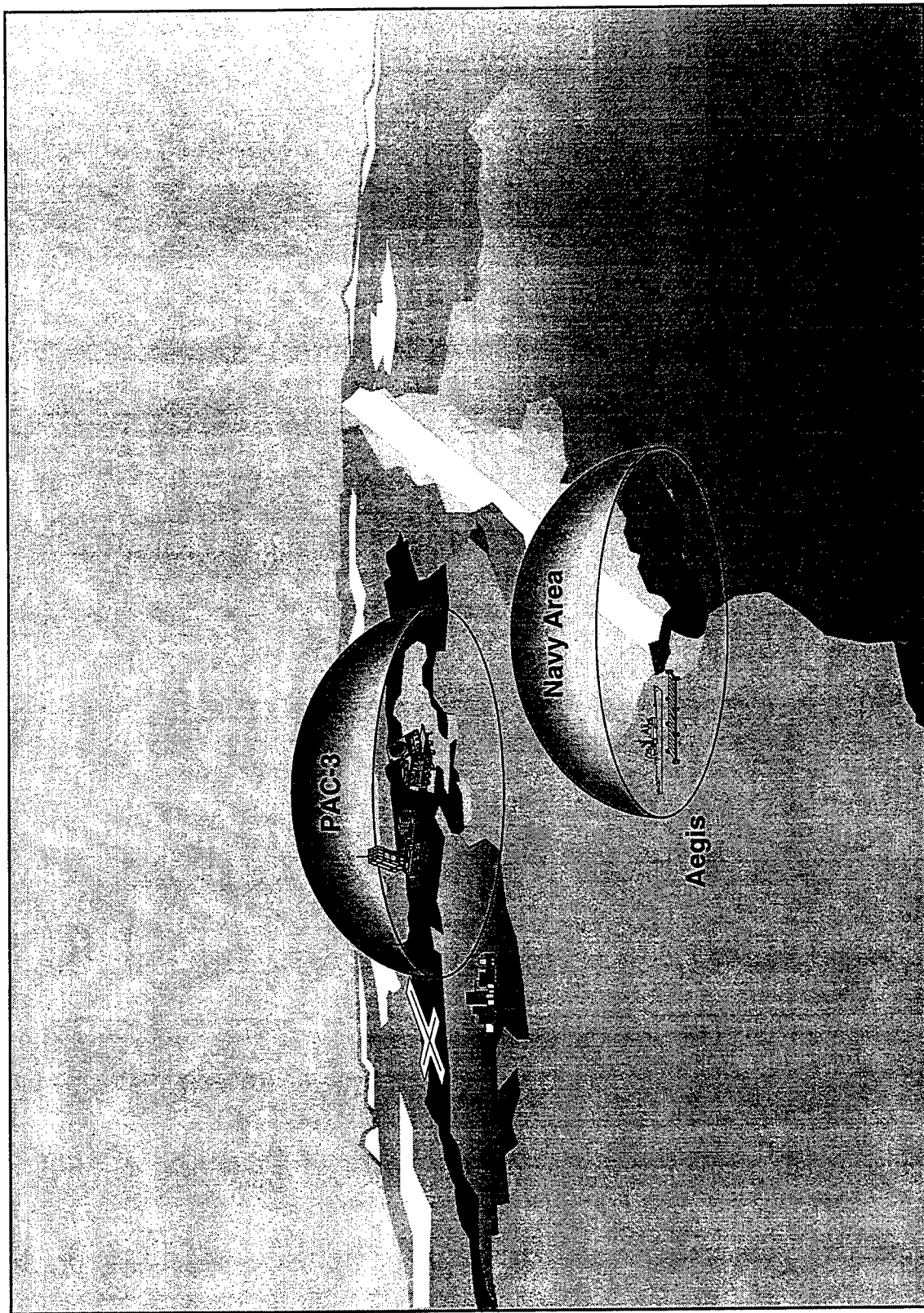
# THEATER MISSILE DEFENSE FIELDED CAPABILITIES







# THEATER MISSILE DEFENSE LOWER TIER

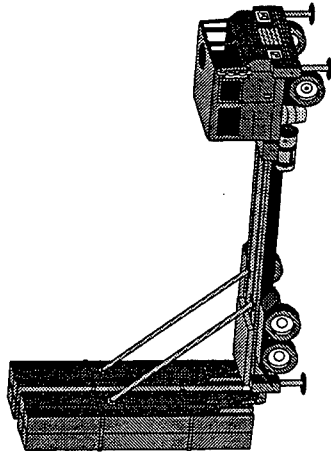






# **MEDIUM EXTENDED AIR DEFENSE SYSTEM (MEADS - FORMERLY CORPS SAM)**

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- Provides 360 Degree Protection Against Short-to-medium-range TBMs, Cruise Missiles, UAVs And Other Air Breathing Threats

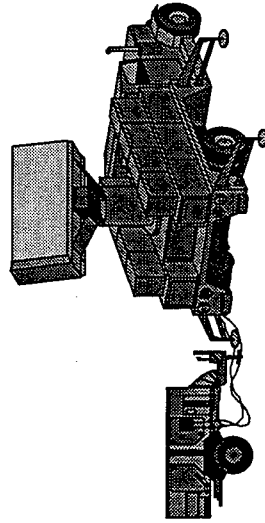
8

- “Designed In” Interoperability With Three NATO Allies (FR, GE, IT)

- Supports Maneuver And Expeditionary Forces

- Status

- International Program Entering Project Definition - Validation Phase







## **NEAR-TERM TMD LOWER-TIER APPROACH**

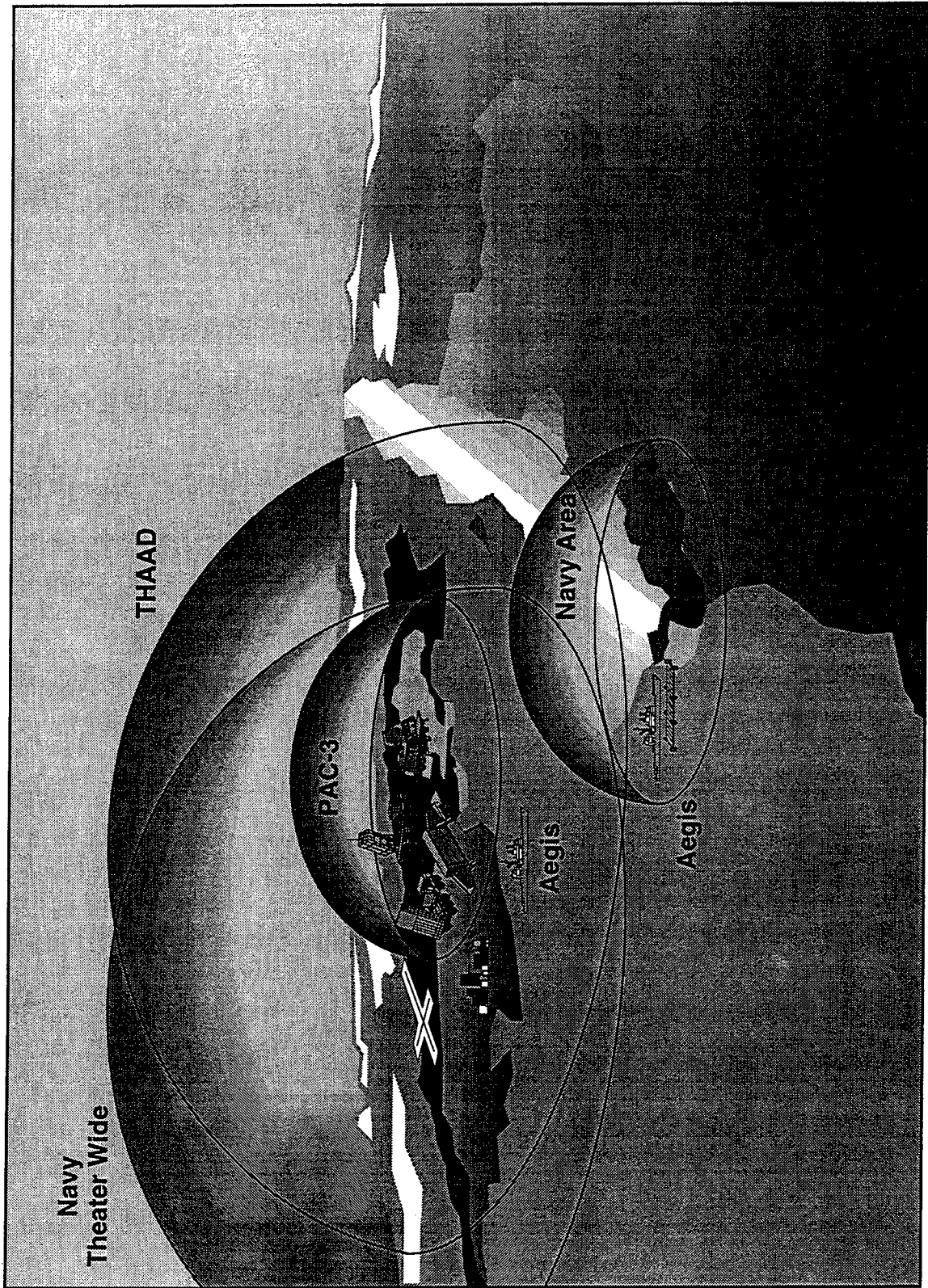
---

- **Field A Capability To Defeat Short-to-medium-range TBMs As Soon As Possible**
- **Build On Existing Infrastructure And Prior Investment**
- **Expand Capability Of Patriot And Aegis / Standard Missile Systems**
- **Add Funds To Deal With Cost Increases And Development Delays**
- **Continue MEADS Program With Allies**
- **Improve Battle Management, Command, Control, And Communications (BM/C<sup>3</sup>) Capability**





# THEATER MISSILE DEFENSE LOWER TIER AND UPPER TIER







## UPPER-TIER APPROACH

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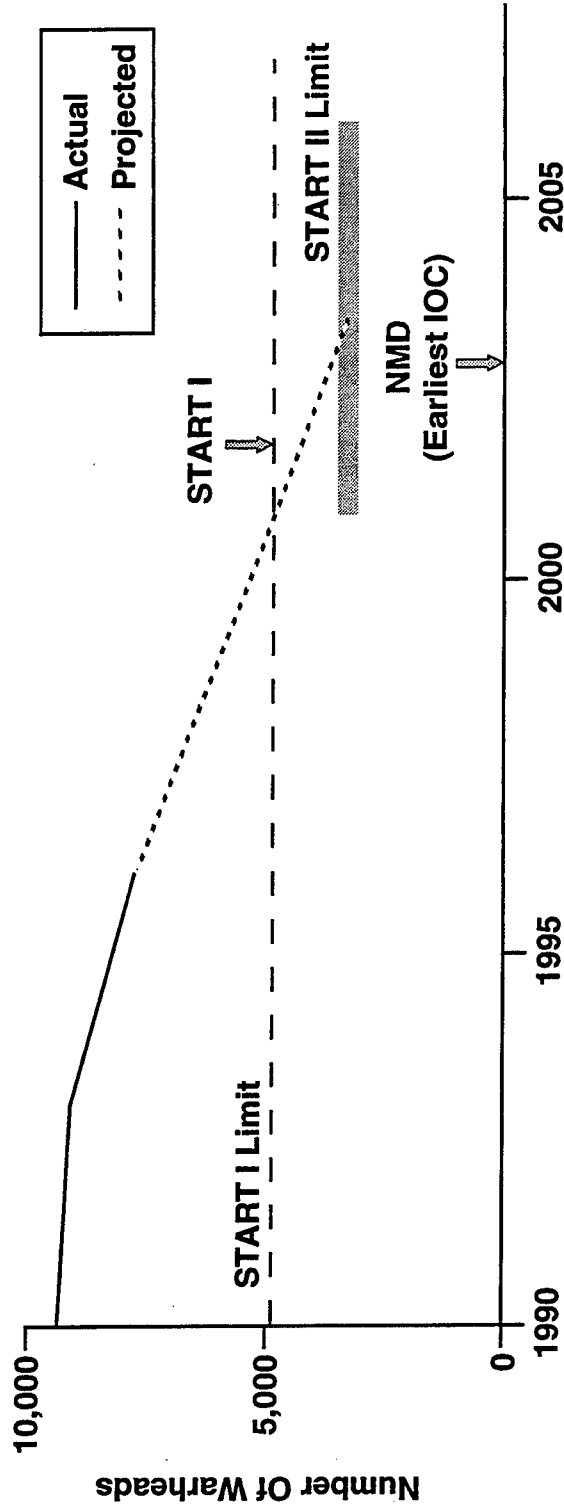
- Continue Development Of The Theater High-Altitude Area Defense (THAAD) System
  - Most Mature Upper Tier System
  - Restructure To Focus On Nearer-term Threat, Reduce Program Risk, And Spend More Slowly
- Proceed With Navy Theater Wide System Assessment And Demonstration
  - Prudent Development Pace To Reduce Technical Risks





# NMD PROGRAM START I AND II IMPLICATIONS

## *Russian Missile Warheads*

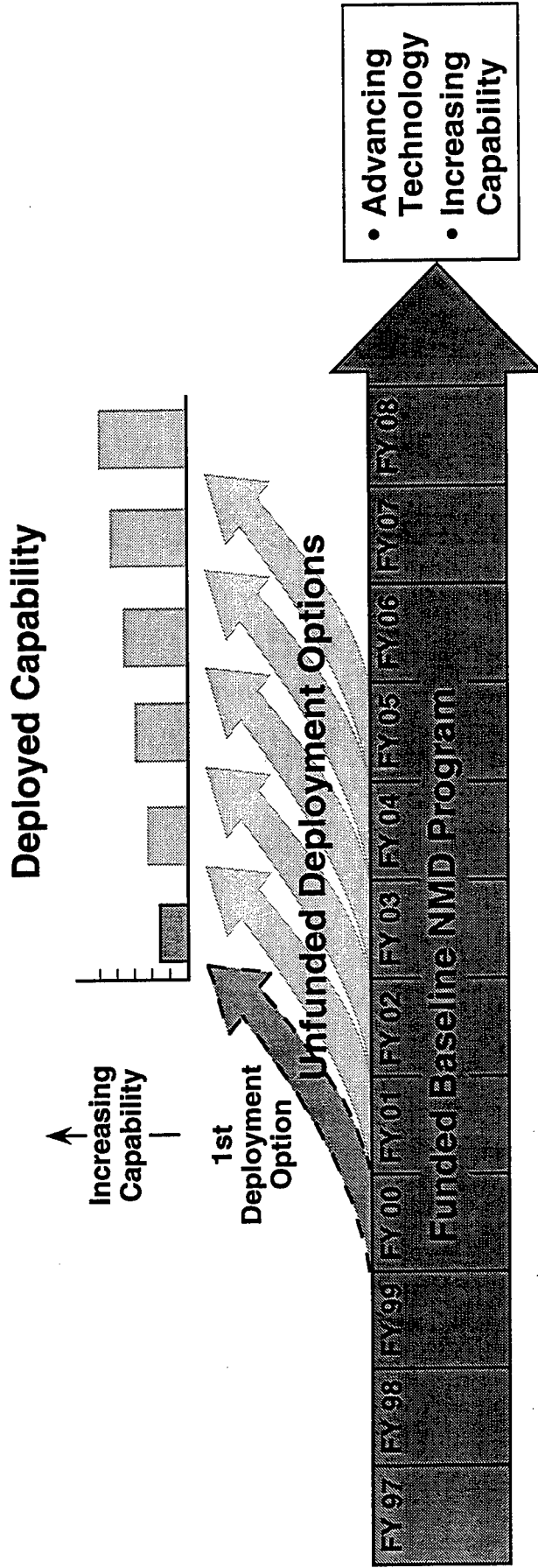


- START I Reduces RV Threat To <4,900 RVs
- START II Further Reduces Threat By 1,400+ RVs





# NMD DEPLOYMENT READINESS PROGRAM



- The Capability Ultimately Deployed Is Greatly Enhanced
  - The Threat
  - Time To Deploy The System
- Deployment Options Will Be Triggered By The Threat





## **CRUISE MISSILE DEFENSE**

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- **Initiatives Outside Of BMD Will Improve Ability Of Sensors, Platforms, And Weapons To Counter Advanced Cruise Missiles**
- **TMD Systems Operate In The Same Battlespace As Other Air Defense Systems**
- **Most TMD Sensors, BM/C<sup>3</sup>, And Weapons Are Also Capable Against Cruise Missiles**
  - **Especially PAC-3, Navy Area TBMD And MEADS**
- **NMD BM/C<sup>3</sup> Architecture Will Be Designed To Promote Interoperability And Evolution To A Common BM/C<sup>3</sup> System For BMD And CMD**





## **BMD TECHNOLOGY BASE**

---

- **Key To Countering Future, More Difficult Threats**
- **Underpins Both TMD And NMD**
  - **Enables Block Upgrades To Baseline Systems**
  - **Performs Technology Demonstrations To Reduce Risk And Speed Technology Insertion**
  - **Advances Basic Technologies To Provide Hedge Against Potential Future Threats**
- **Concepts For UAV / Kinetic Energy Interceptor - Boost-Phase Intercept Capability (Backup For Air Force Airborne Laser)**
- **Maintain Space Based Laser Effort For Possible Far Term Boost-phase Intercept Solution**





# **BALLISTIC MISSILE DEFENSE SUMMARY**

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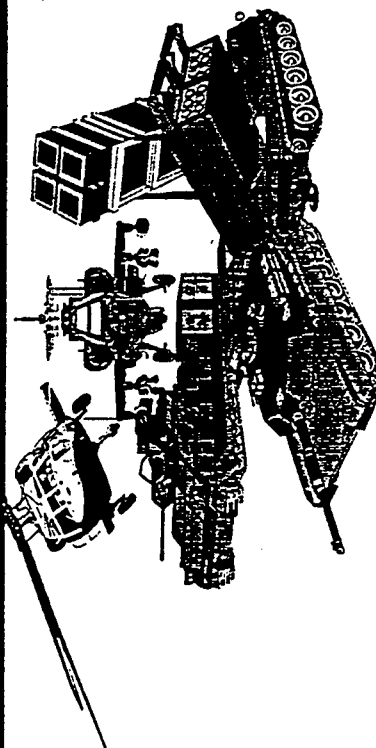
- **BMD Remains A Priority**
  - **BMD Priorities**
    1. **TMD**
    2. **NMD**
    3. **Technology Base**
- **BMD Program Changes Respond To Threats, Program Status, And Fiscal Reality**
  - **TMD**
    - **Fully Support Lower Tier Systems**
    - **Upper Tier - Phased Deployment With Benefits From NMD Technology**
  - **NMD**
    - **Shift Focus To Deployment Readiness**
    - **Develop Within 3 Years Elements Of An Initial System That Could Be Deployed Within 3 Years Of A Decision**
  - **Cruise Missile Defense - Integrated Through BM/C<sup>3</sup> Efforts**
  - **Technology Base**
    - **Focus On Critical Technologies To Counter Future Threats**



AMERICA'S ARMY



# Missile Defense in Tomorrow's Army



**MG Jan A. Van Prooyen**

*Deputy for Systems Management & International Cooperation, Assistant Secretary of the Army  
(Research, Development & Acquisition)*

THE FORCE OF CHOICE



# ***The Army's Challenge***



- **Stabilize the Army Following Turbulent Downsizing**
- **Protect Our Ground Forces And Nation With Cost-Effective Missile Defense Systems Designed and Built to Counter a Real and Growing Threat**

***Army Missile Defense Is a Key Element of Our Defense Strategy***

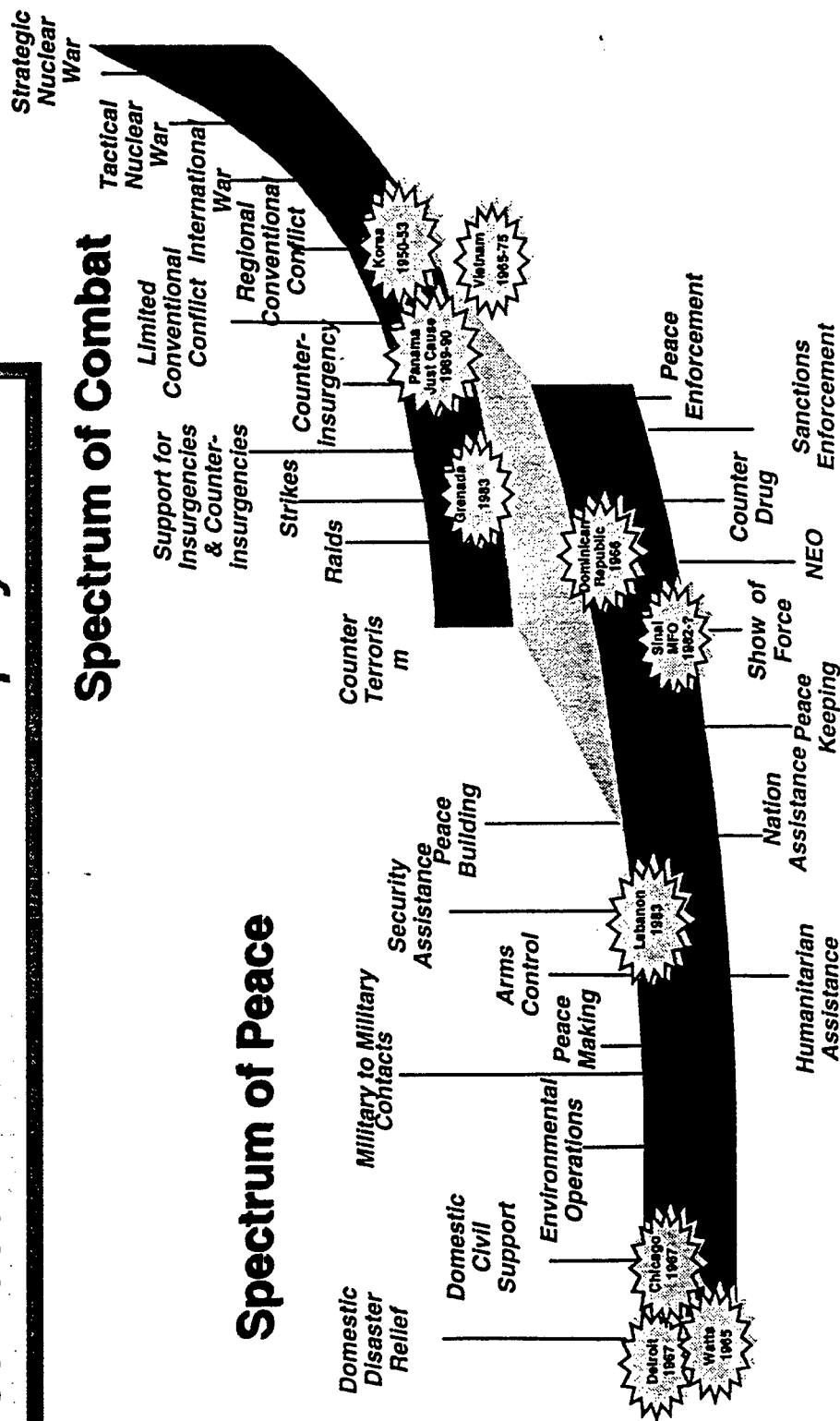




AMERICA'S ARMY

# Spectrum of Military Operations

1950-1989 -- 40 Years -- 10 Deployments



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MDW9603

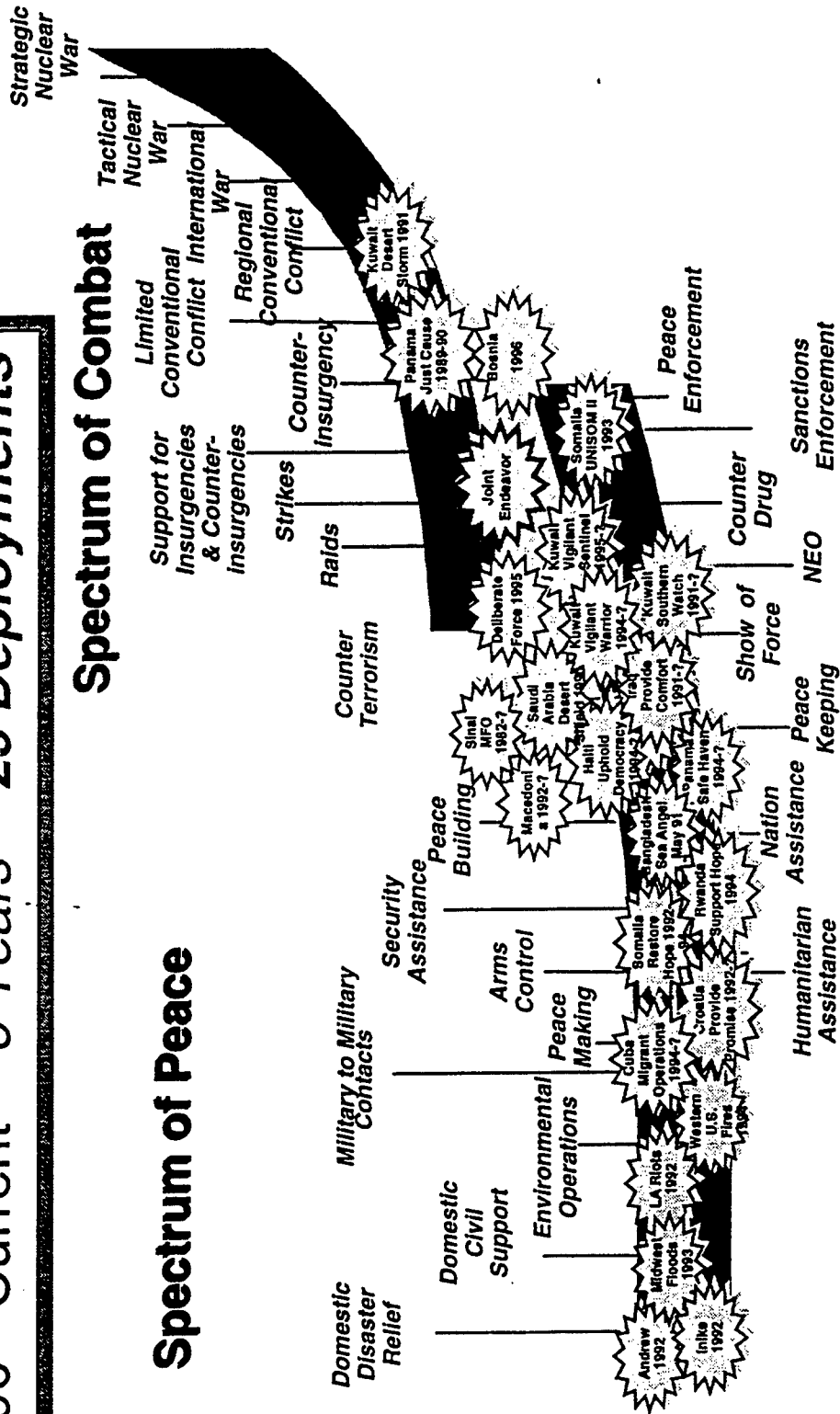




AMERICA'S ARMY

# Spectrum of Military Operations

1990 - Current -- 6 Years -- 25 Deployments



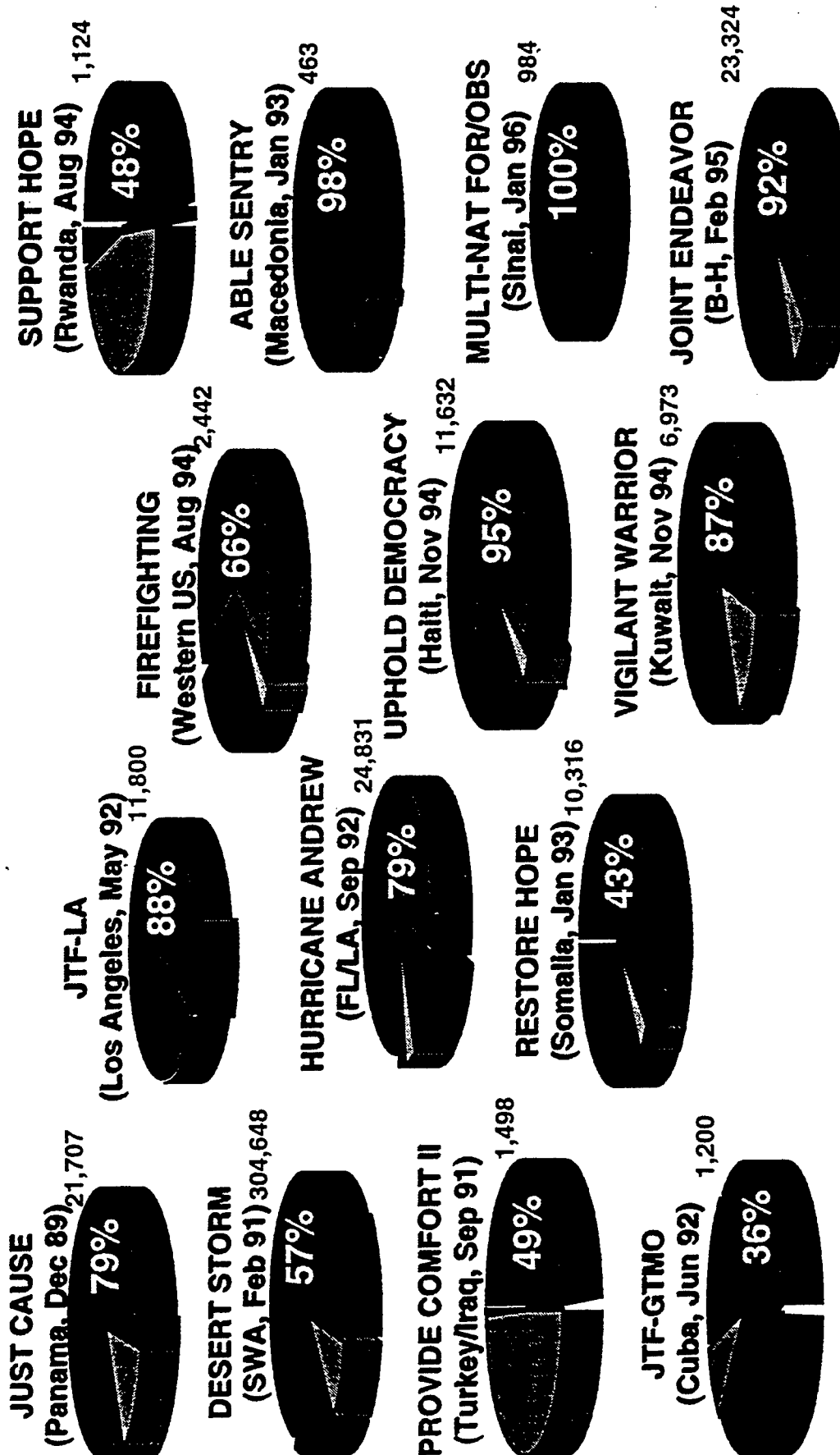
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— AMERICA'S ARMY —

## JOINT FORCE COMPOSITION



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# Modernization--

Yesterday & Today



PRESENT

"Big 5"  
Systems



CAPABILITIES  
BASED

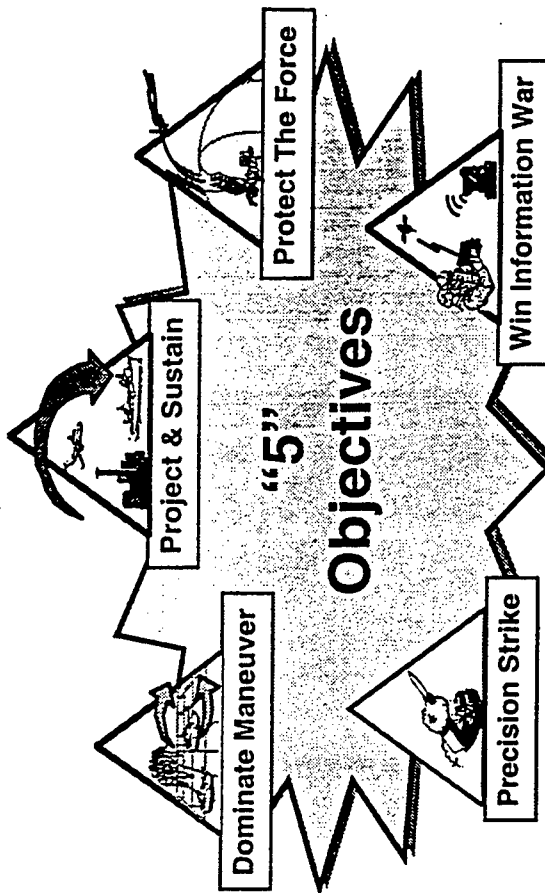
... in the 21st Century

... in the 1980s ...

THREAT BASED

PAST

"5"  
Objectives



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MDW9616



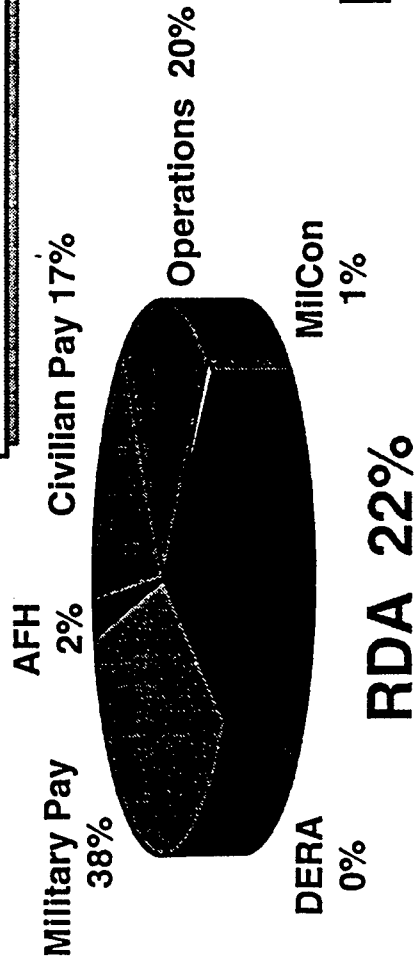


# Army Program Balance

FY97 CONSTANT \$BILLIONS

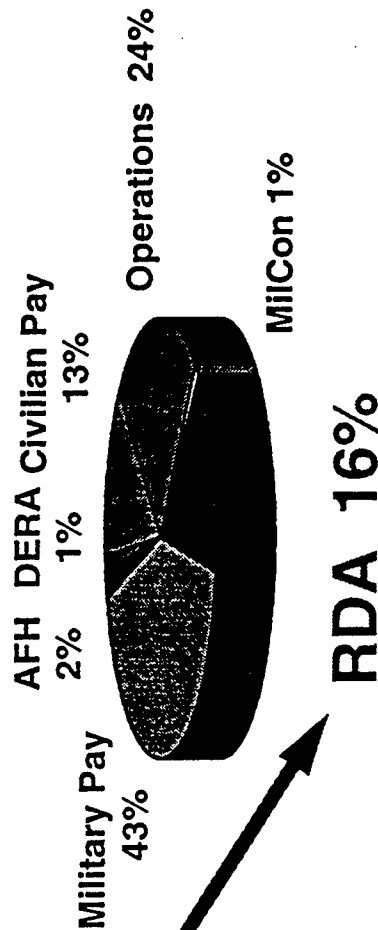
**FY90**

TOA = \$94.5B (FY97\$)



**FY97**

TOA = \$60.1B (FY97\$)



*The Army's Modernization  
Accounts Are Now a  
Smaller Piece of a Smaller  
Pie!!!*

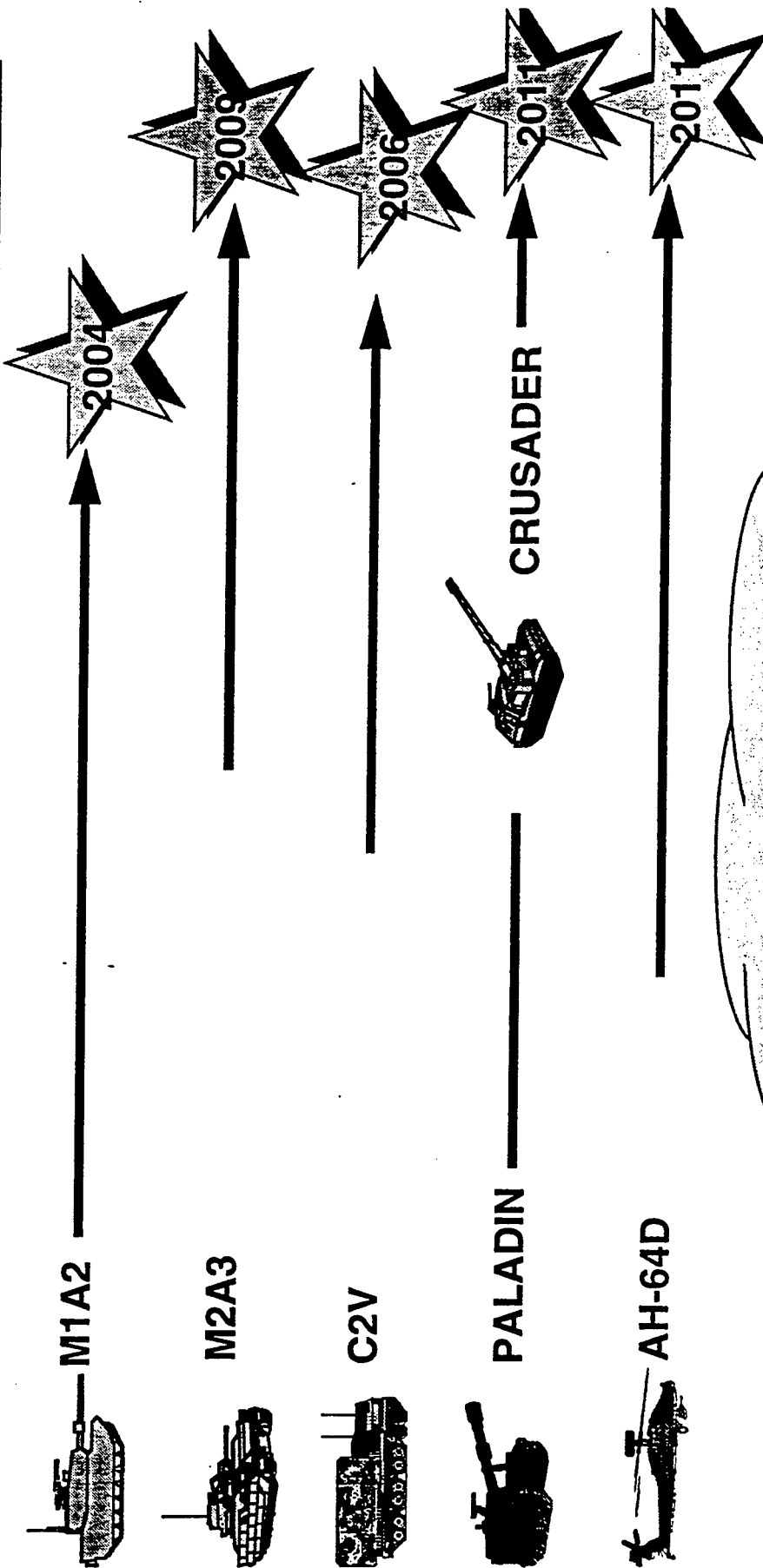
- MPA 5%
- Civilian Pay 4%
- Operations 4%
- RDA 6%



# Inadequate Fielding Rate



96 97 98 99 00 01 02 03 04 05 06







**MAKING THE TOUGH DECISIONS**



As one of our warfighting CINCs remarked --  
*"We are in danger of gutting the future of the  
Army . . . The risk of breaking the force is a  
real one."*

From CPA





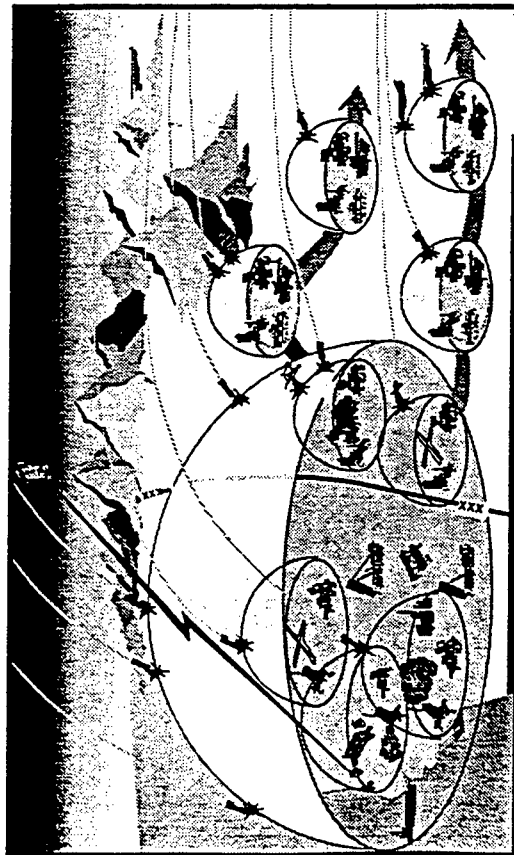
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AMERICA'S ARMY

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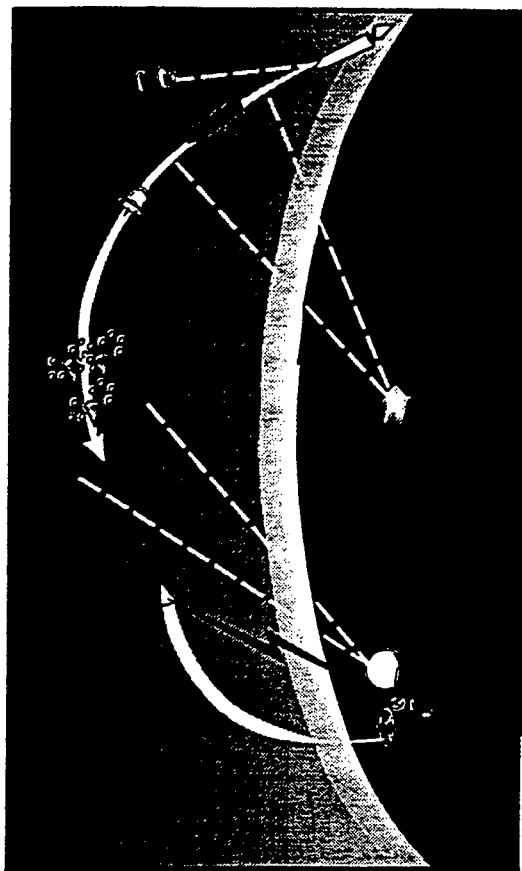


## Army Missile Defense Strategy



### Theater Missile Defense

- Effective
- Deployable
- Interoperable



### National Missile Defense

- Effective
- Affordable
- Treaty Compliant

*Protecting Force XXI ...*

*... And The NATION*

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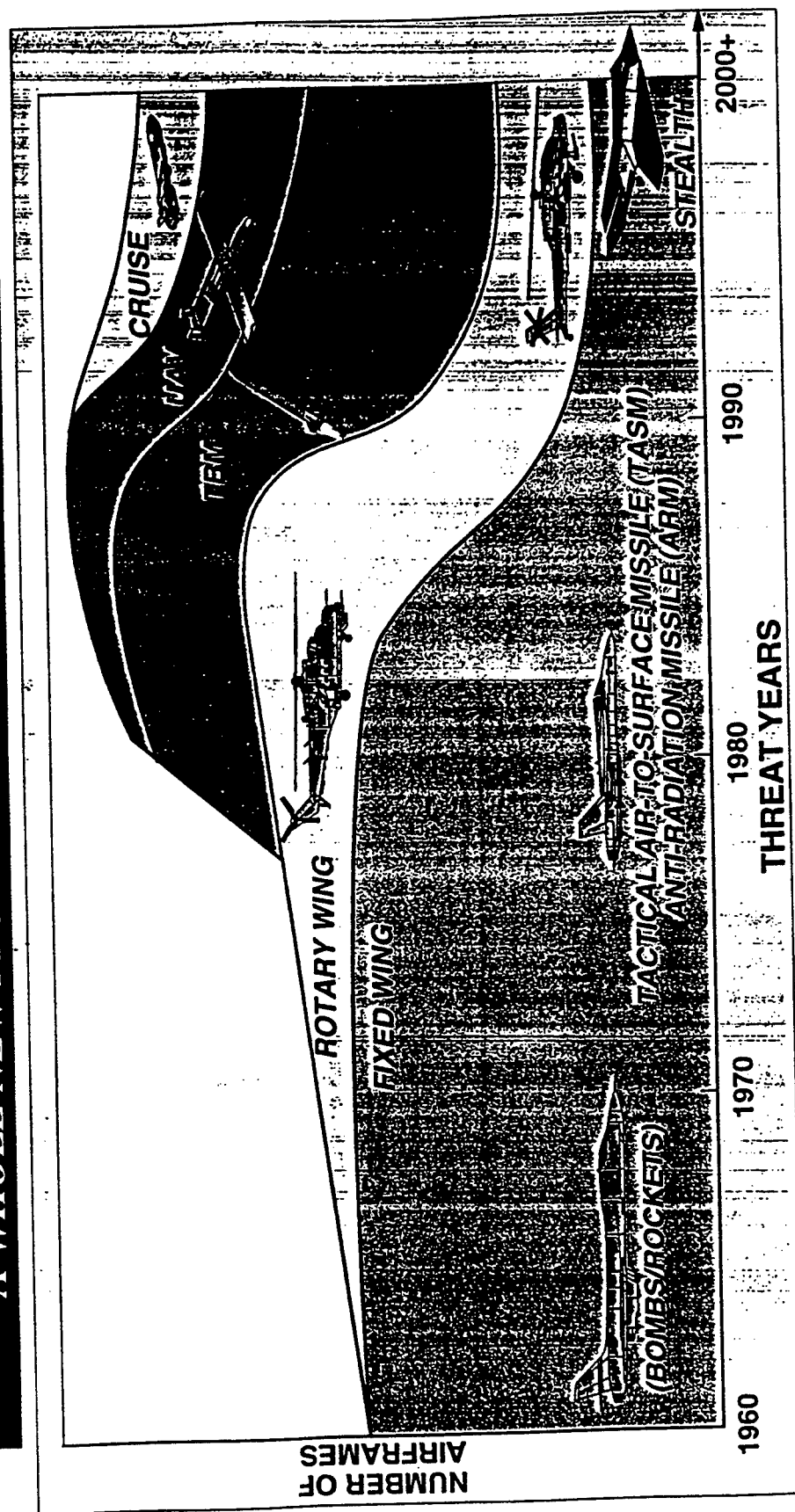


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# AIR AND MISSILE THREAT EVOLUTION

TACTICAL MISSILES AND UNMANNED AERODYNAMIC VEHICLES  
**A WHOLE NEW PROBLEM FROM COLD WAR EUROPE**



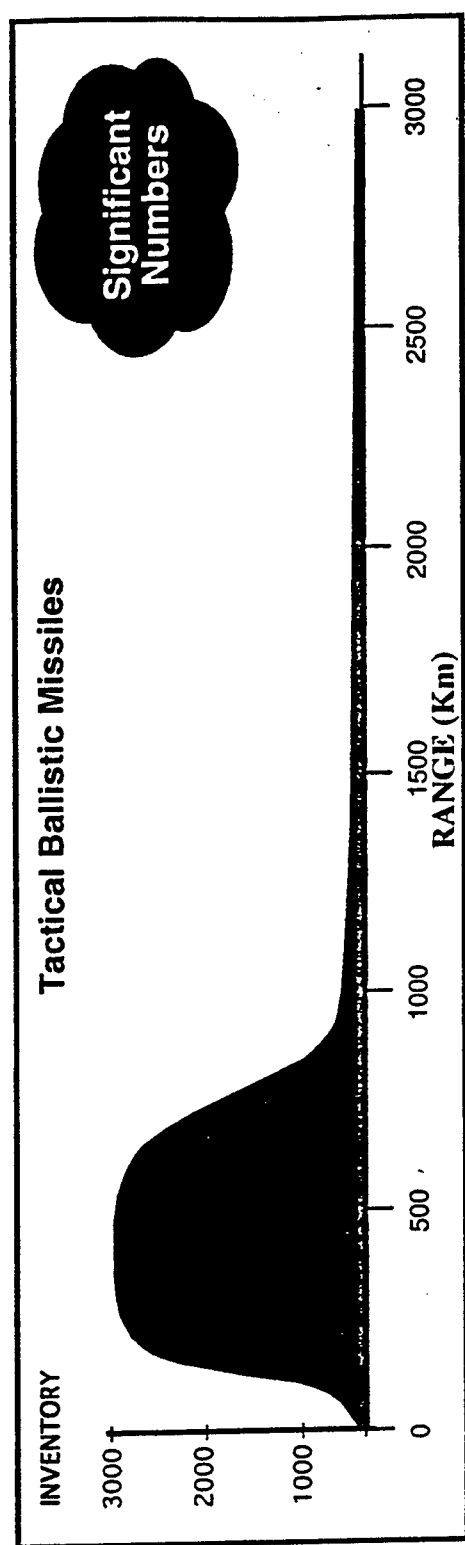
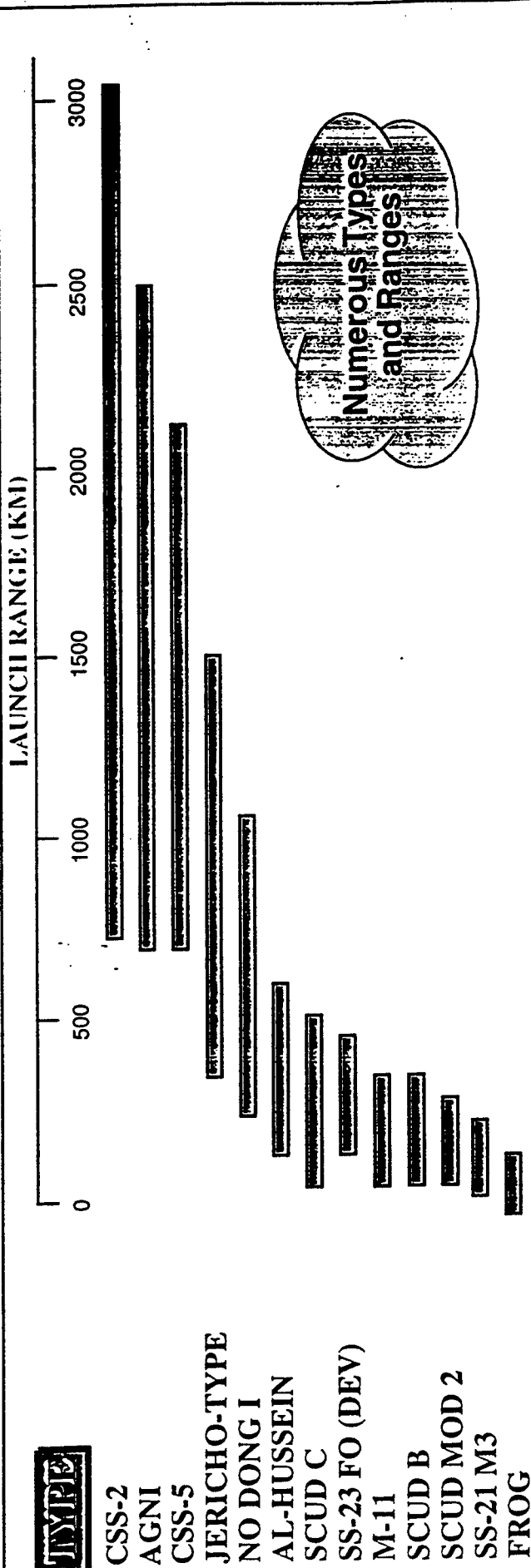
**HIGH TECHNOLOGY APPLIED WORLDWIDE**





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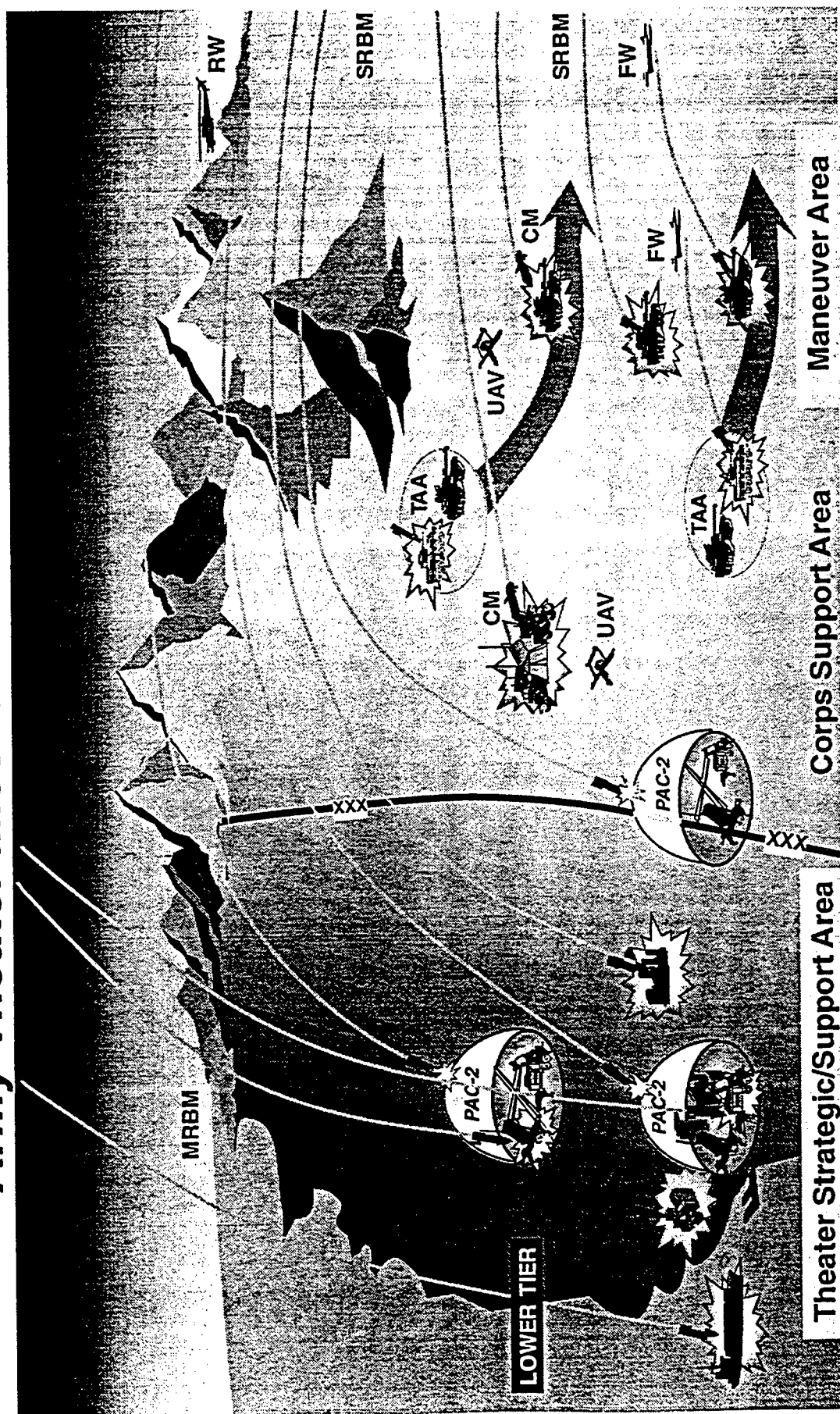
# TBM THREAT - REAL & PROLIFERATING







# Army Theater Missile Defense - Current



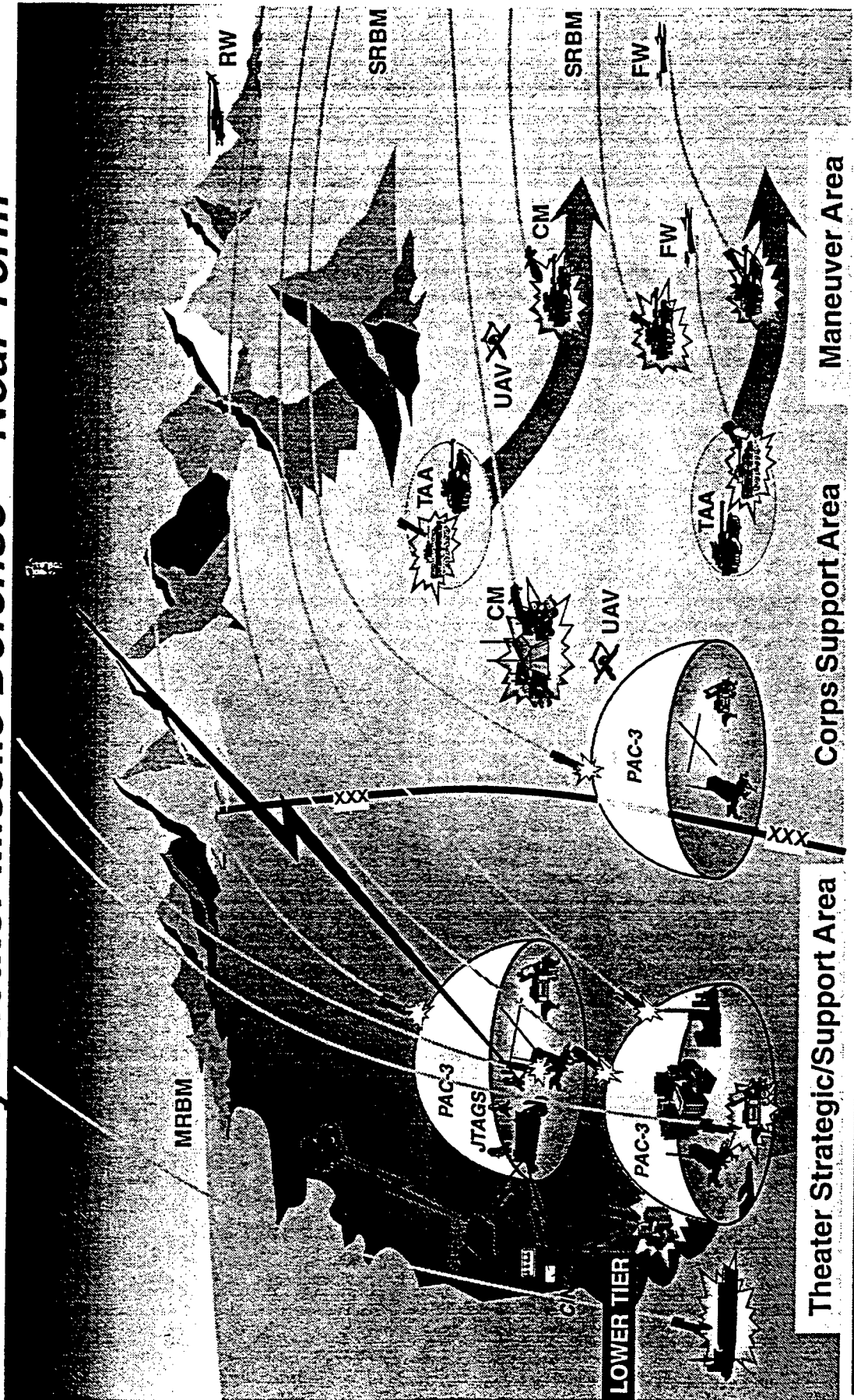
# THE FORCE OF CHOICE





AMERICA'S ARMY

## Army Theater Missile Defense - Near Term



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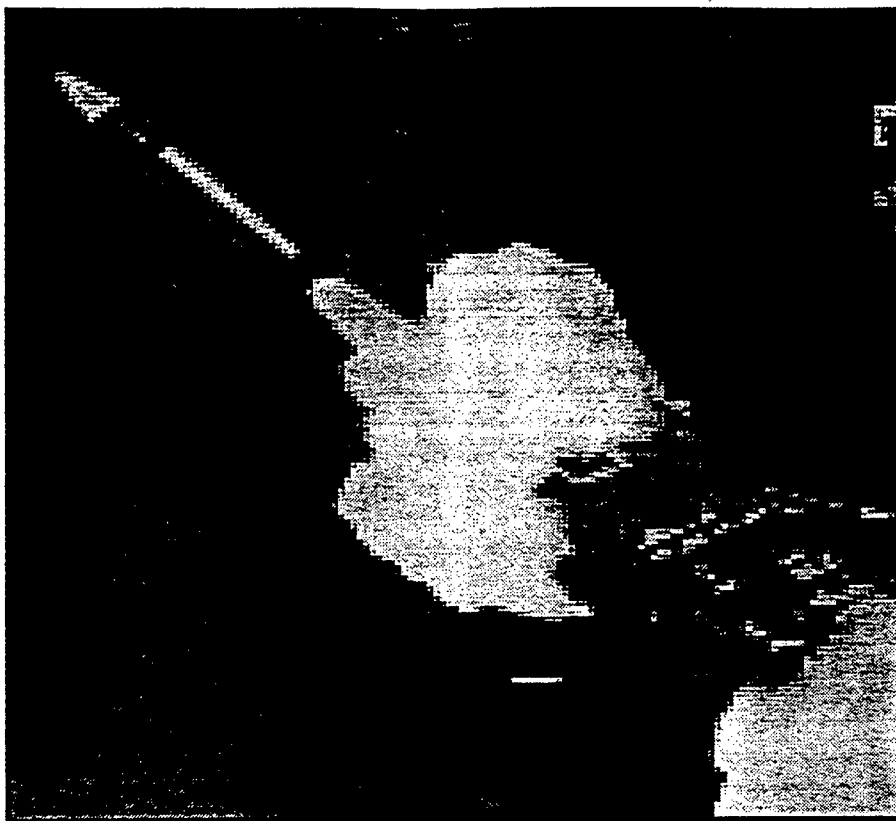
## *PATRIOT Advanced Capability-3 (PAC-3)*

### MISSION

Provides High-to-Medium Air Defense Against Aircraft, Cruise Missiles, And Tactical Ballistic Missiles

### HIGHLIGHTS

- Desert Storm QRP (Lethality/Accuracy) Fielding Is Complete
- PAC-3 Expands Defended Area, Improves Target Discrimination & Tracking
- PAC-3 Missile Hit-to-Kill Lethality
- PAC-3 Development And Testing To FUE One battery In 4QFY99







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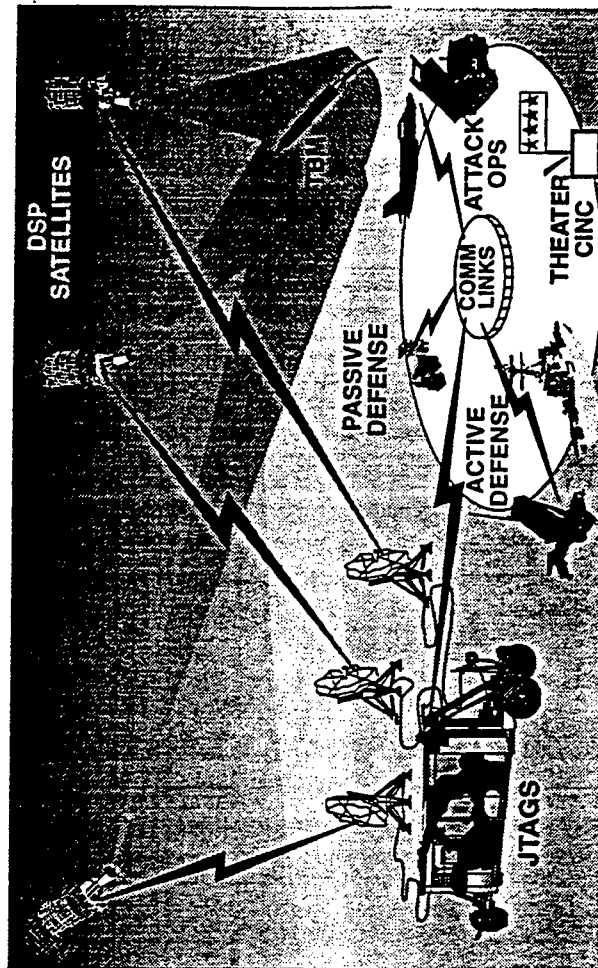
## Joint Tactical Air Ground System (JTAGS)

### MISSION

Provides Theater With Real Time, Space-Based Infrared Warning Of Tactical Ballistic Missile Launches & Other Tactical Events

### HIGHLIGHTS

- Acquisition Streamlining Success
- Corrects Desert Storm TBM Early Warning Deficiencies
- Provides Threat Warning And Cueing Directly To Theater Commanders
- Currently In Production
- Field In FY 97



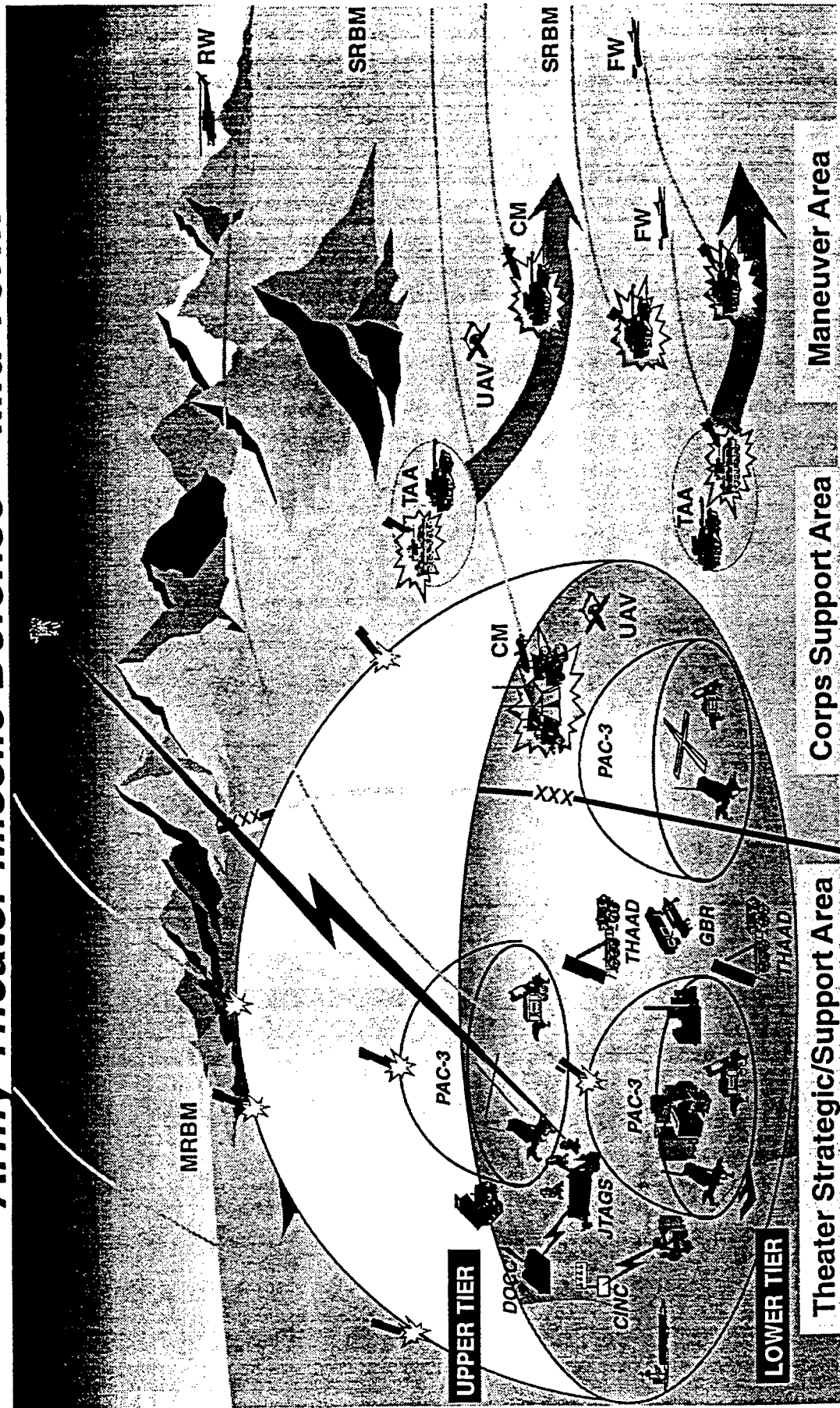
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AMERICA'S ARMY

## Army Theater Missile Defense - Mid Term



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## *Theater High Altitude Area Defense (THAAD)*

### MISSION

Provides High Altitude Air Defense of Mature & Non-Mature Theaters Against Tactical Ballistic Missiles

### HIGHLIGHTS

- Provides Upper Tier Defense For Near Leak Proof Protection With Lower Tier
- Endo- And Exo-Atmospheric Engagement Capability
- Uses Hit-to-Kill Lethality
- In Dem/Val Phase of Development
- User Operational Evaluation System In FY98 For Testing Or For A National Emergency

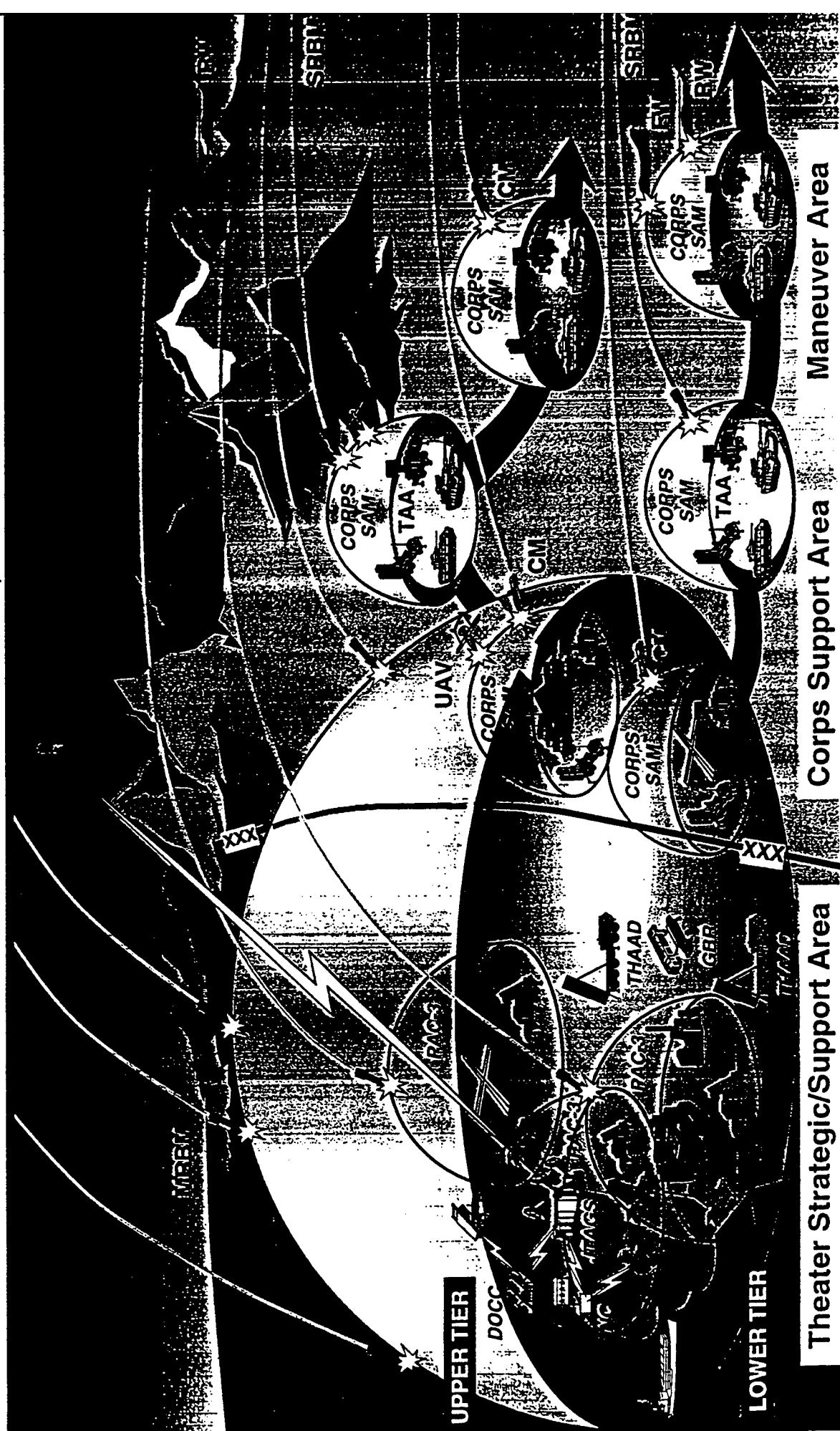


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# ARMY THEATER MISSILE DEFENSE OBJECTIVE



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MD0711A/020896





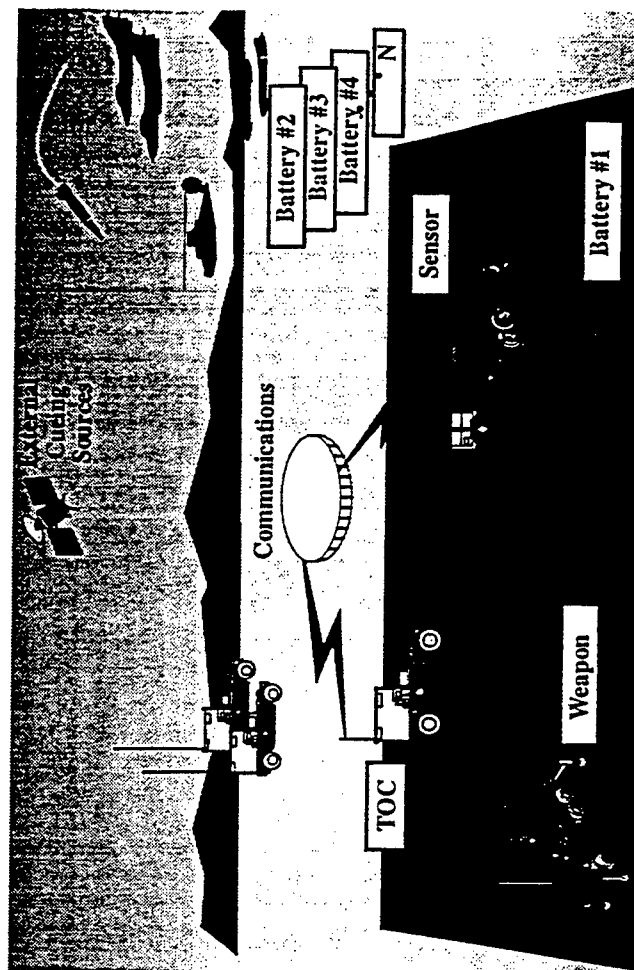
## ***Medium Extended Air Defense System (MEADS)***

### **MISSION**

**Defends Corps Maneuver Forces  
& Critical Assets Against  
Ballistic Missiles & Air Breathing  
Threats In Contingency & Mature  
Theaters**

### **HIGHLIGHTS**

- **International Cooperative Program (US/GE/FR/IT)**
- **Strategically Deployable & Tactically Mobile**
- **360 Degree Coverage**
- **Interoperable With Other Army, Services & Allied Systems**
- **Awaiting MOU Signature to Begin Program**







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## Recent NMD Program History



•GPALS System/  
BMC3 MDAP

•NMD Second Priority

•National Priority For  
NMD Is Elevated

•NMD MDAP

•Reduce Technology  
Long Poles

•Appropriation: NMD  
Plus-Up In FY96

•UOES Deployment  
Scheduled FY97

•Develop for Deployment •“3+3” Program

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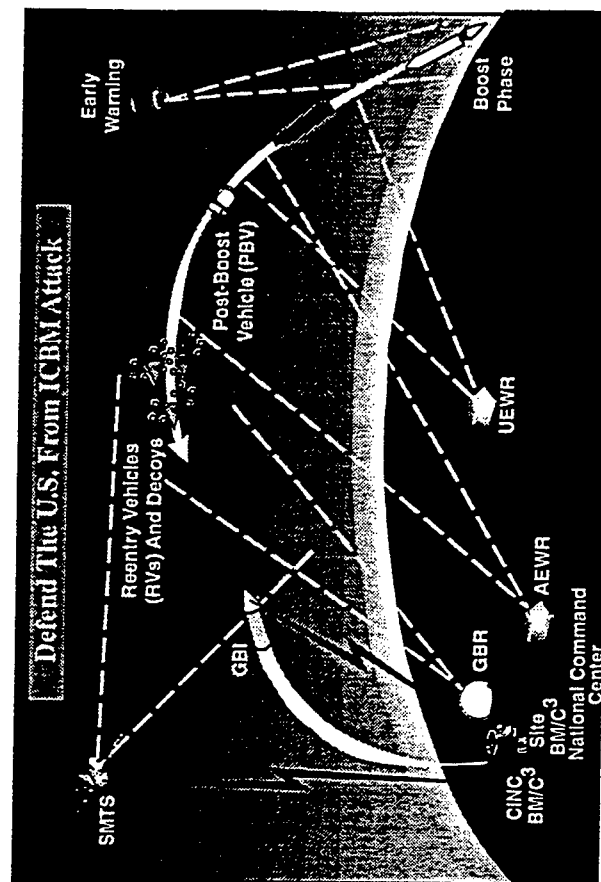
## National Missile Defense (NMD)

### MISSION

Provide Protection To U.S. From Limited ICBM Attacks

### HIGHLIGHTS

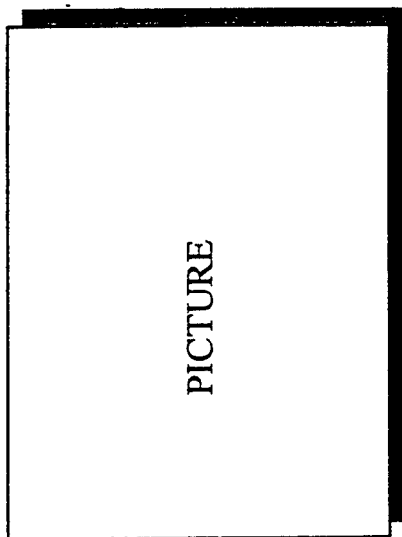
- "3 + 3" Program Seeks To Enable a Deployment Decision in 3 Years
- Integrated System Testing Along Vandenberg - Kwajalein Corridor In FY99
- Work Done In Parallel To Reduce Deployment Timelines, Including Site Preparation





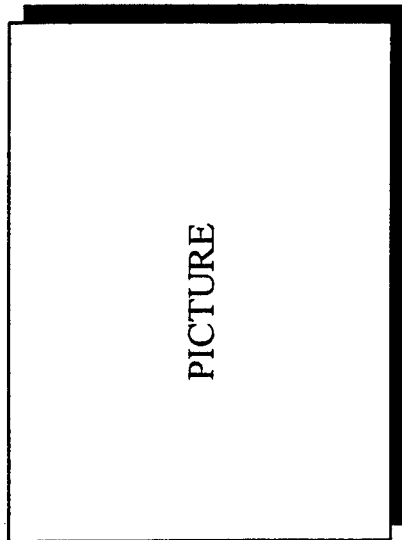
# KEY TECHNOLOGY THRUSTS

COMMUNICATIONS



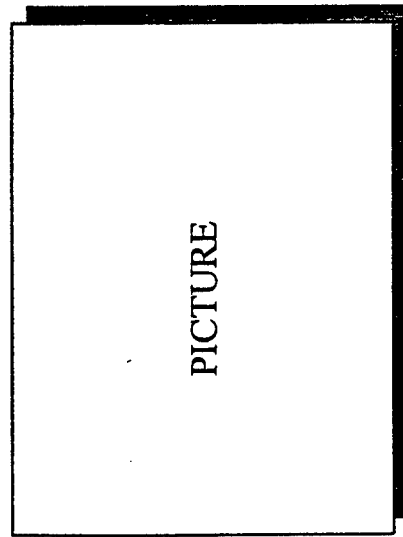
PICTURE

SENSORS



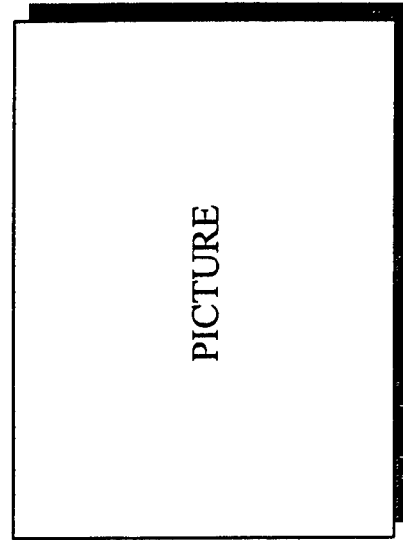
PICTURE

PROCESSORS



PICTURE

INTERCEPTORS



PICTURE



# Summary



## Two Key Themes:

- Urgent Need to Stabilize the Army Following a Period of Downsizing
- We're Building Missile Defense Systems to Counter a Real and Growing Threat and Protect Ground Forces

*Army Missile Defense Is a Key Element of Our Defense Strategy*

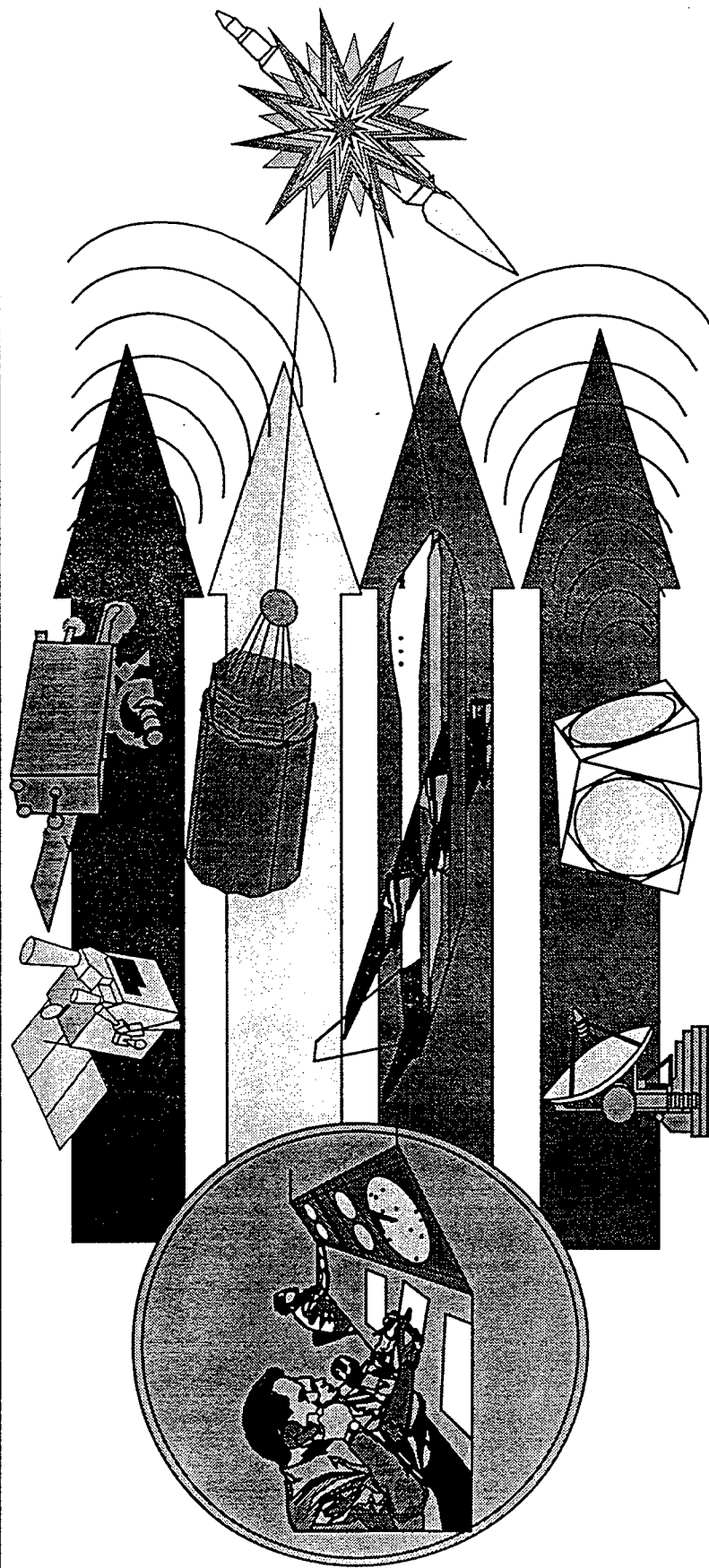
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MDW9609



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# Missile Defense in Tomorrow's Air Force



Major General John W. Hawley  
Director, Global Power Programs  
Secretary of the Air Force (Acquisition)  
9 April 1996

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# Overview

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- Vision
- Global Surveillance
- Global BMC4I
- Multi-Tiered Defense



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# Air Force Missile Defense Vision

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*A mix of capabilities required:*

- Global Deterrence: Minimize launches
- Multi-tiered Defense: Minimize leakers
- Fully integrated BMC4I: Increase Effectiveness
- Joint training and execution: Fully exploit warfighting capability

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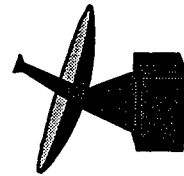
# Global Surveillance



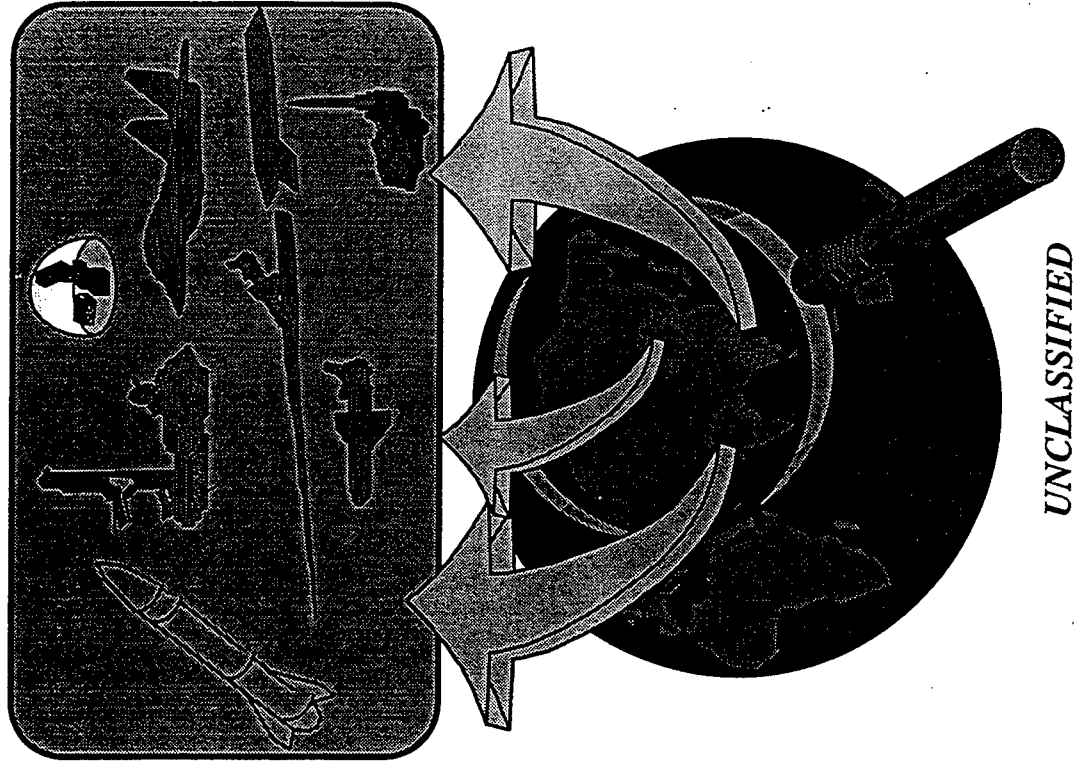
Satellite Constellations



Airborne Platforms



Radar Networks



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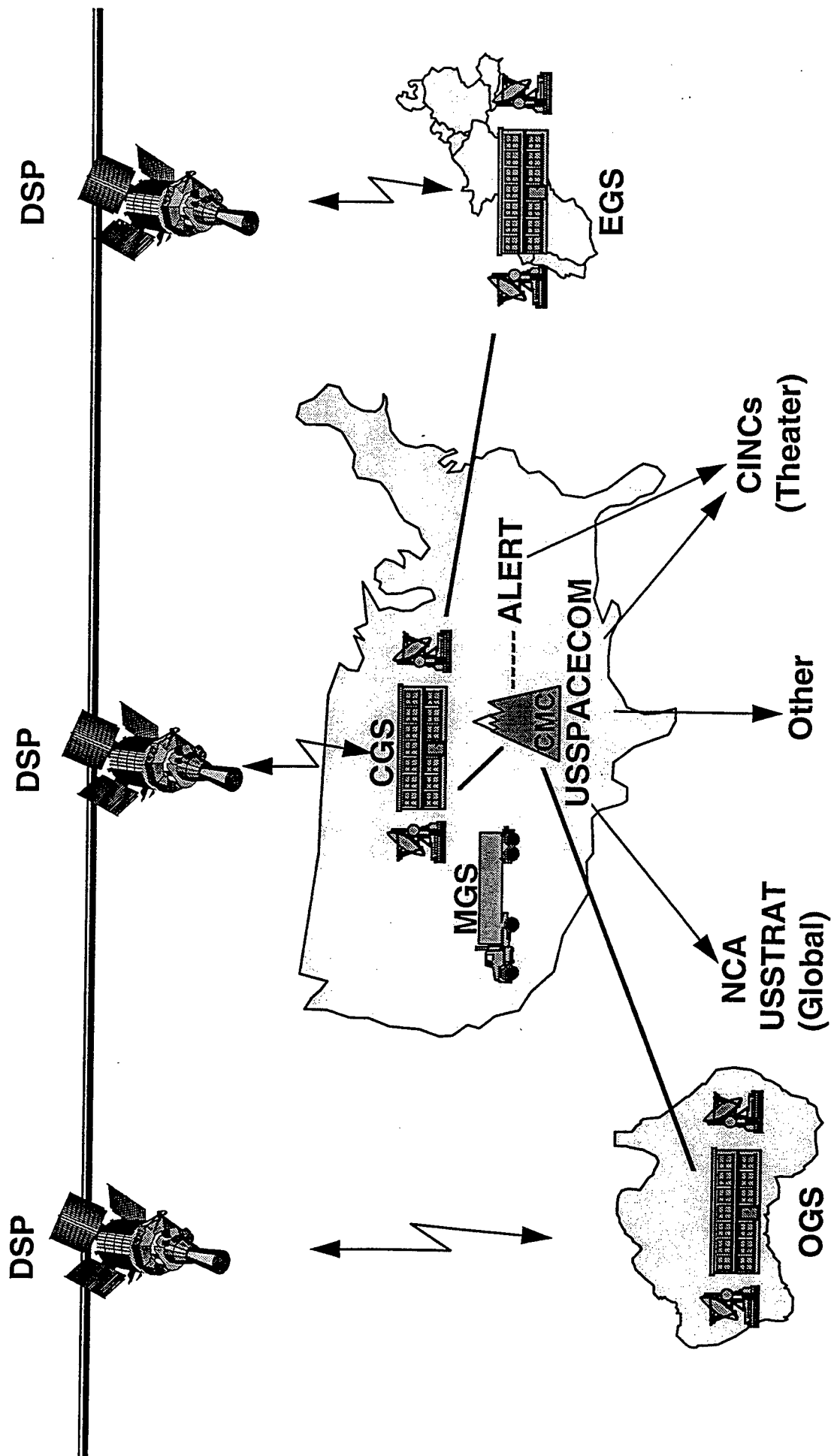
# Global Surveillance





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# Space Based Infrared System - Today

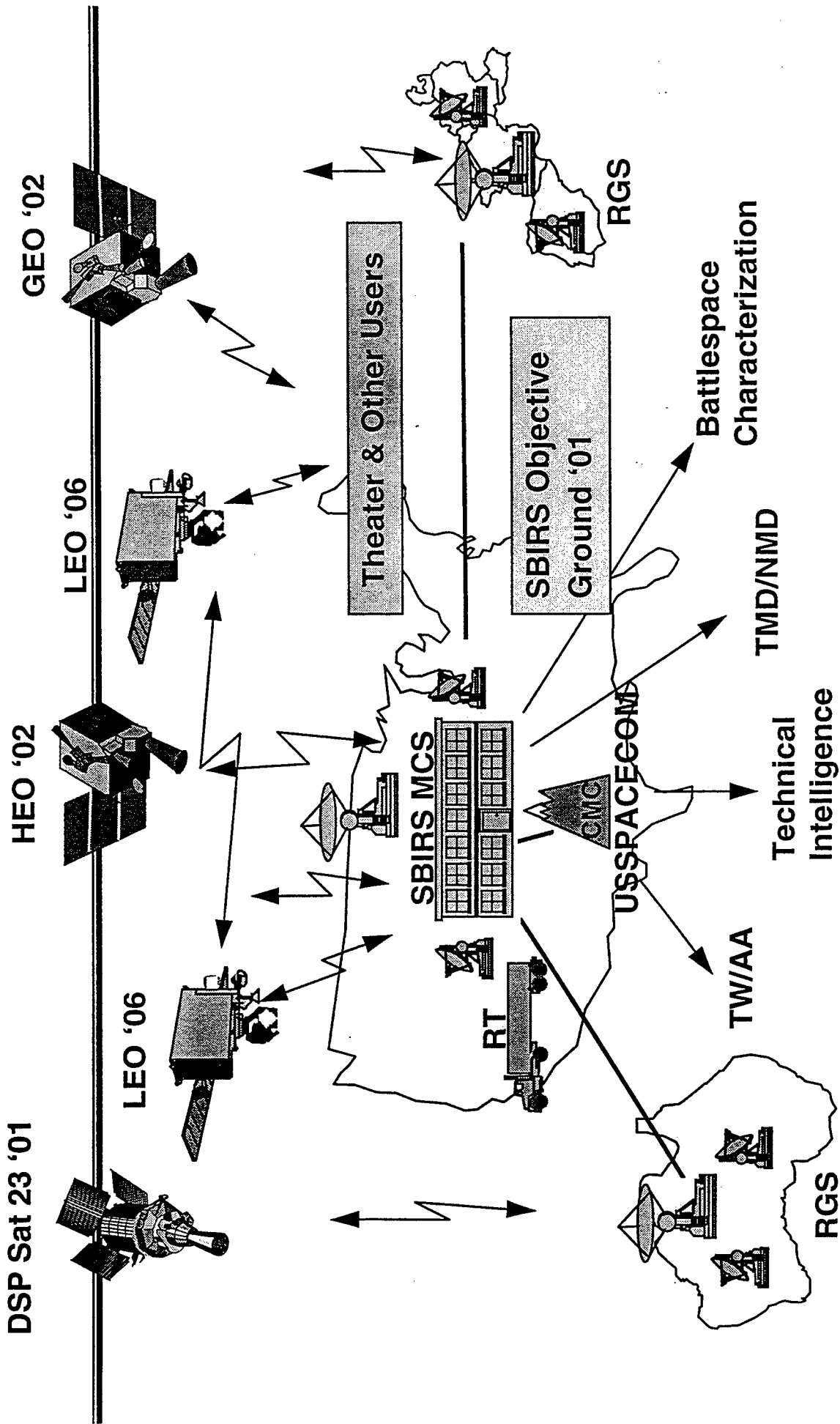


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# Space Based Infrared System - 2006



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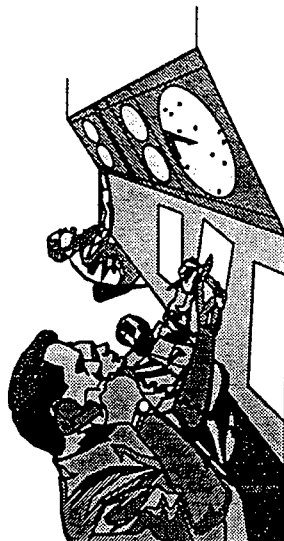


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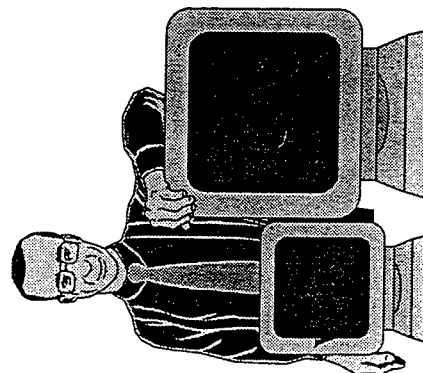
# Global BMC4I



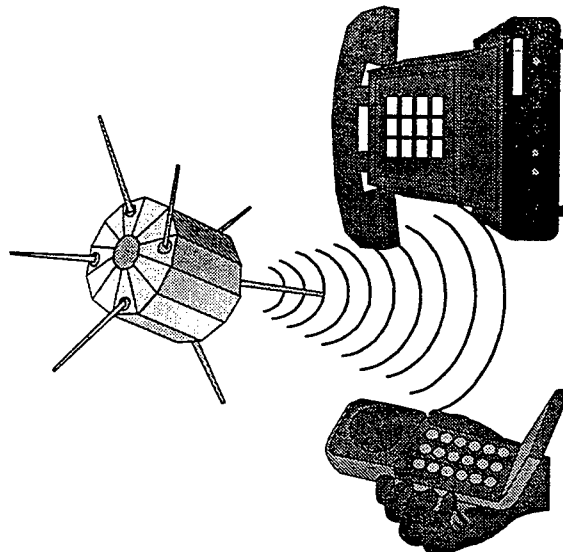
Battle Management



Command and Control



Computers



Communications



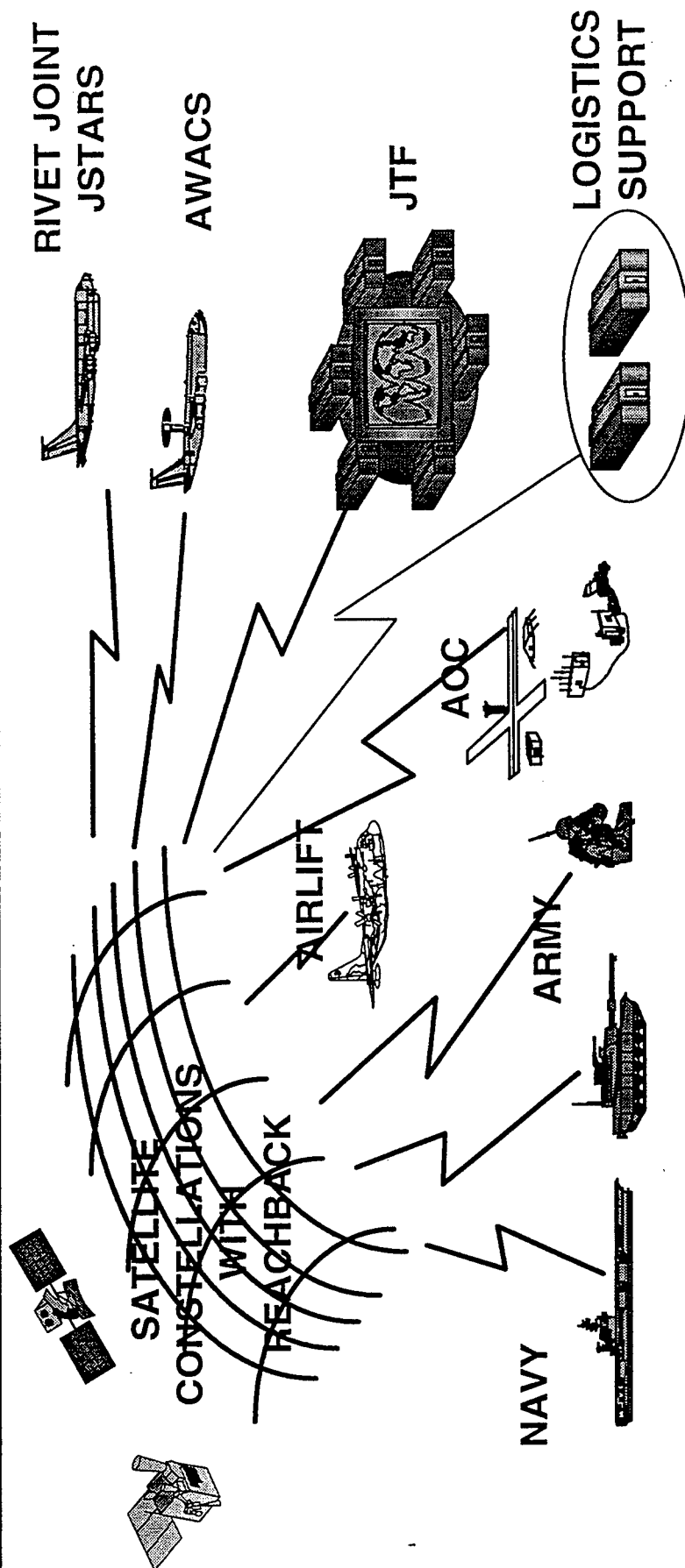
Intelligence

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# Global BMC4I



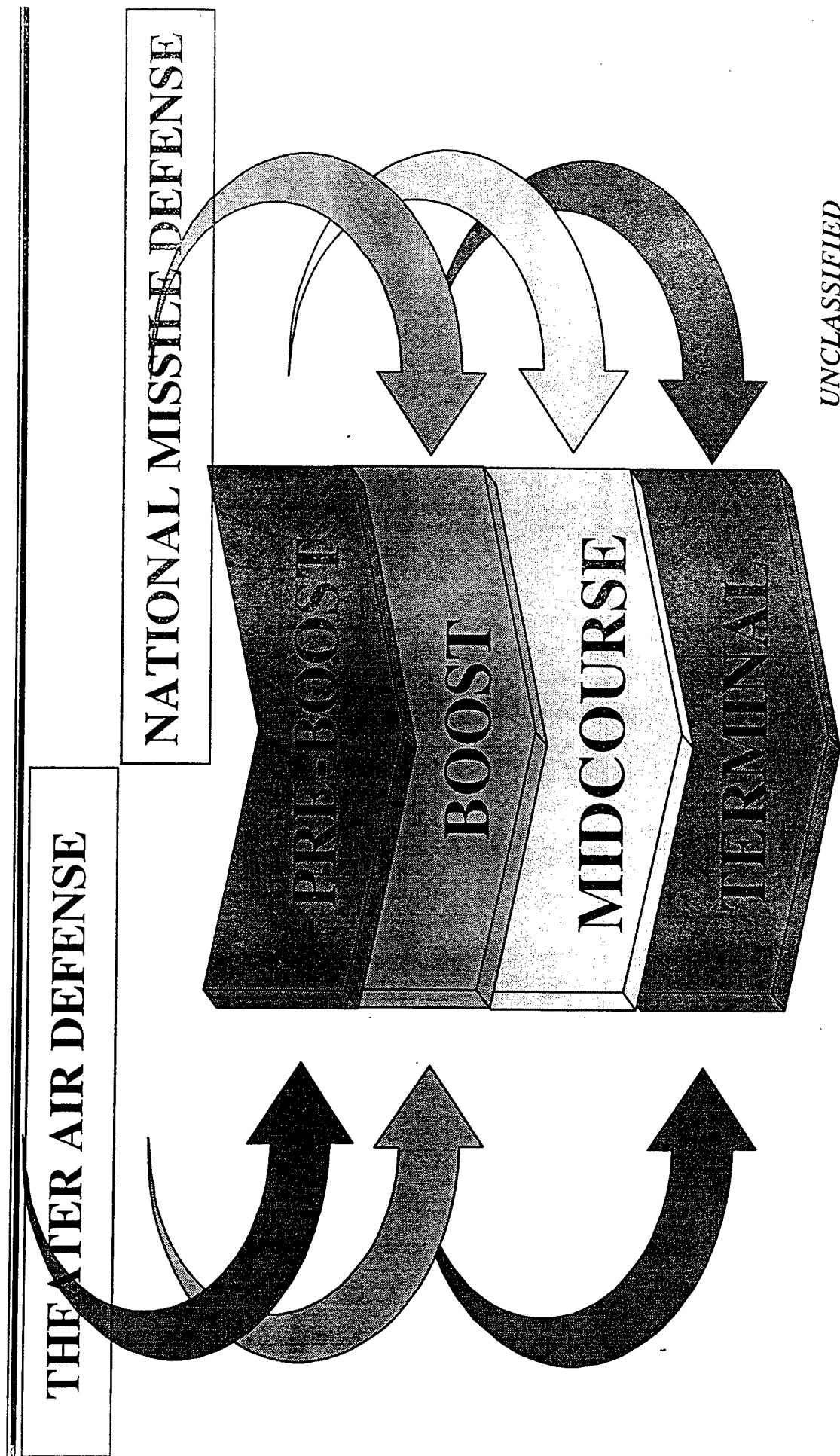
Get the Right Information to the Right People  
at the Right Time

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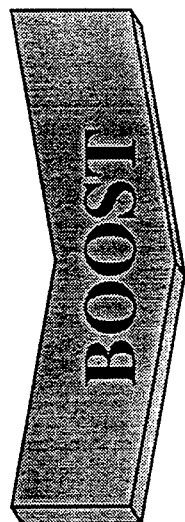
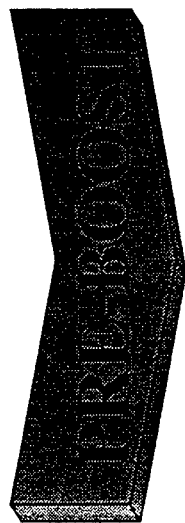
# Multi-Tiered Defense



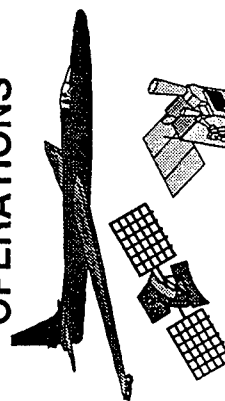


UNCLASSIFIED

# Multi-Tiered Defense



ATTACK  
OPERATIONS



SURVEILLANCE



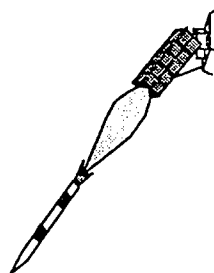
ABL

SBL

UAV



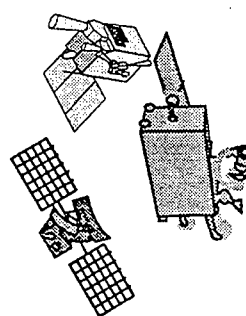
THAAD



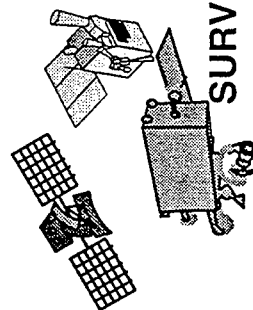
PATRIOT/ERINT



AEGIS



SURVEILLANCE



SURVEILLANCE

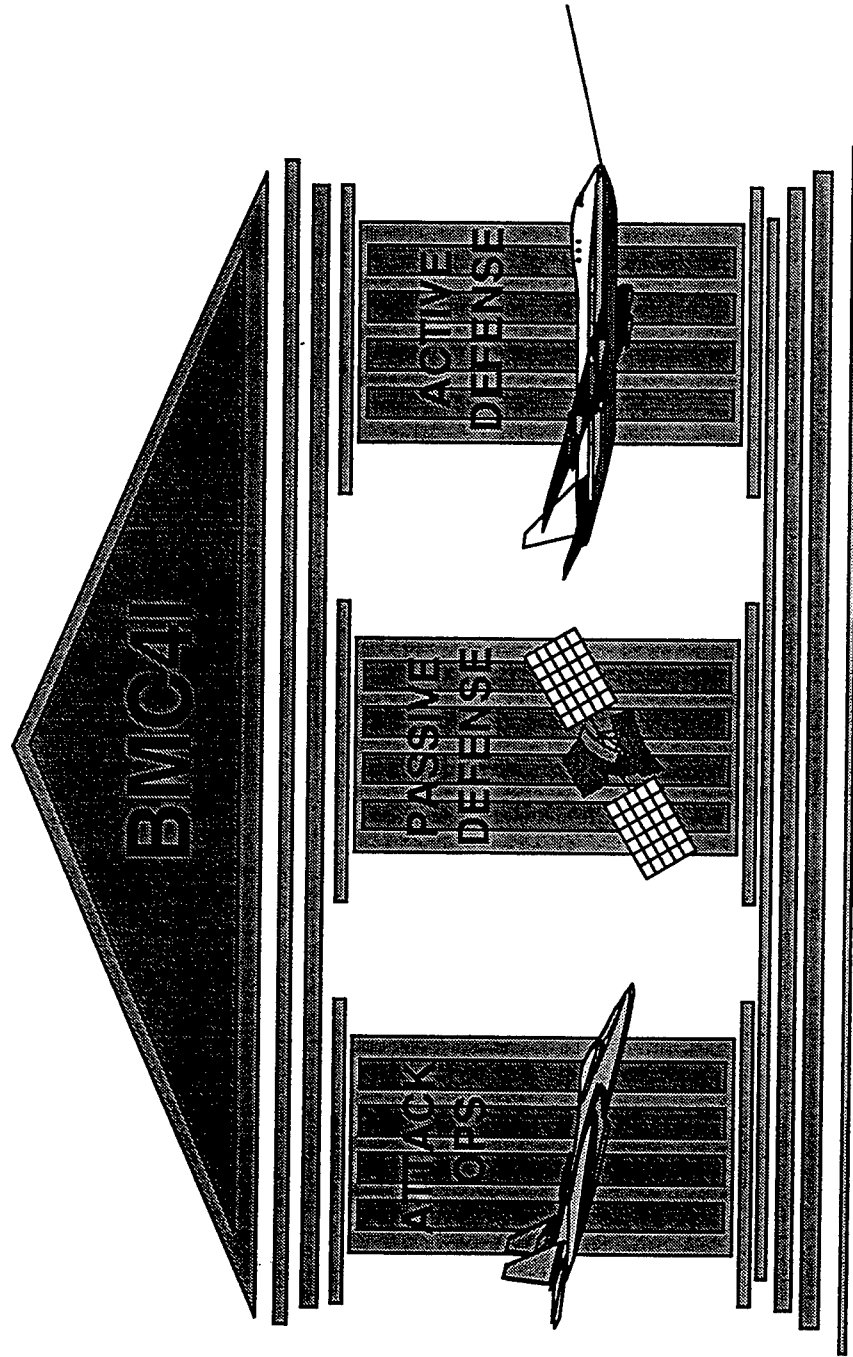
THEATER AIR DEFENSE

UNCLASSIFIED



UNCLASSIFIED

# Theater Air Defense

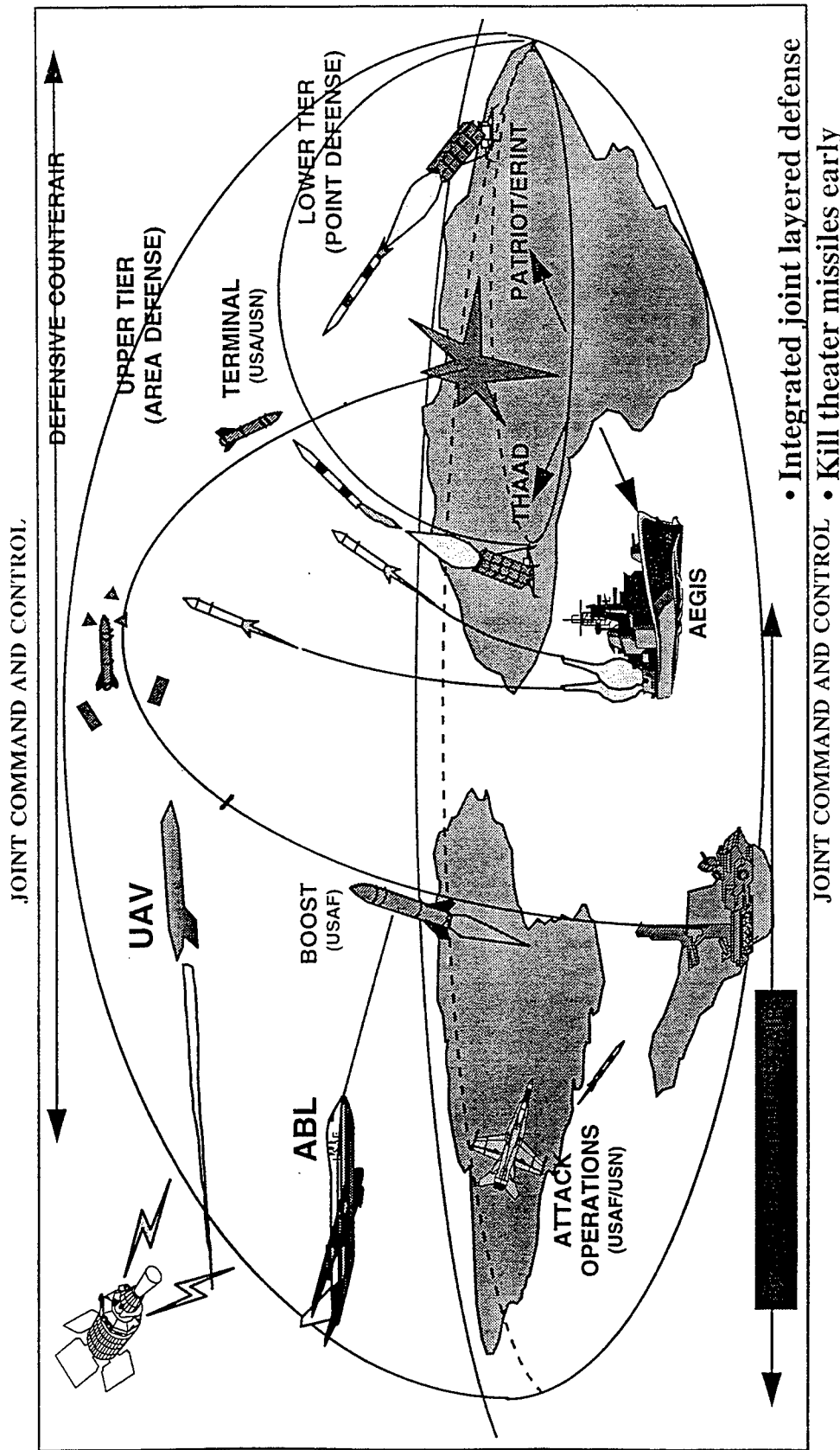


UNCLASSIFIED



UNCLASSIFIED

# Theater Air Defense

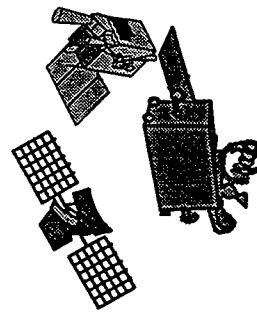
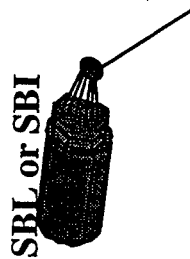


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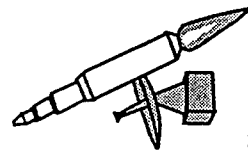
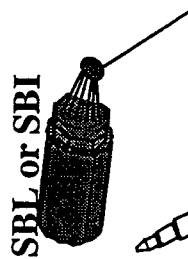
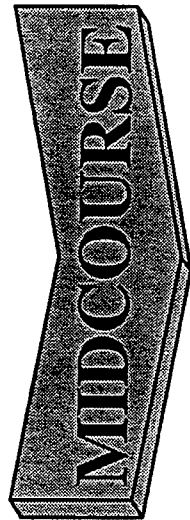


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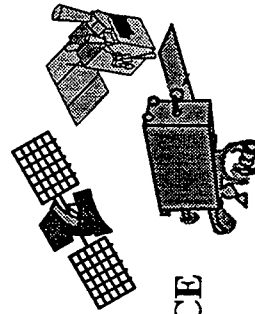
# Multi-Tiered Defense



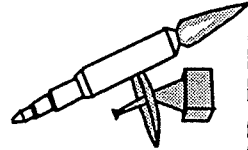
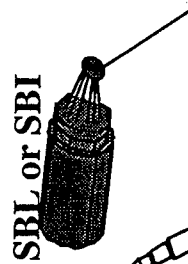
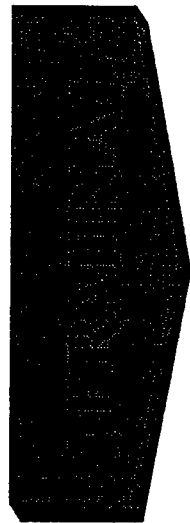
SURVEILLANCE



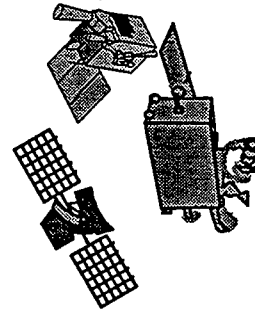
GRD INT



SURVEILLANCE



GRD INT



SURVEILLANCE

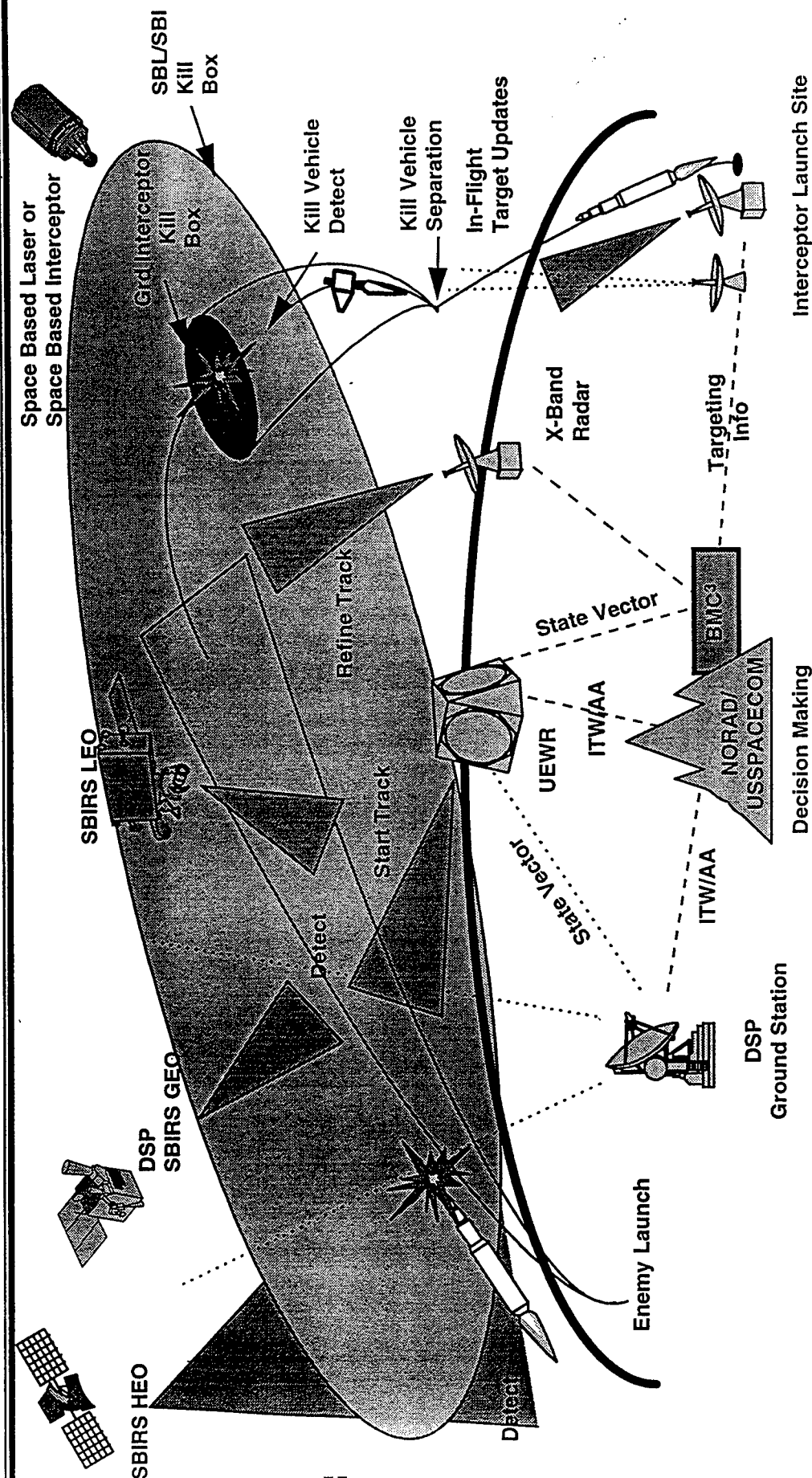
NATIONAL MISSILE DEFENSE

UNCLASSIFIED



UNCLASSIFIED

# National Missile Defense



UNCLASSIFIED



# Summary

---

- Future Missile Defense requires:
  - Joint integrated multi-tiered defense
  - Integrated national and theater coverage
  - Building on existing and developing new technology
  - Joint BMC4I to leverage capabilities of all warfighters
  - International cooperation and interoperability



# Surveillance Technology (Sensors)



April 1996

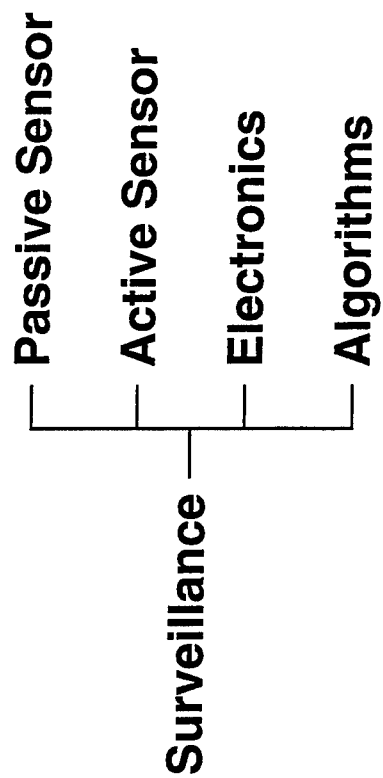
Col William C. Smith, USAF  
Sensor And Phenomenology Technology Directorate  
Technology Readiness Deputate  
Ballistic Missile Defense Organization





# SURVEILLANCE TECHNOLOGY OVERVIEW

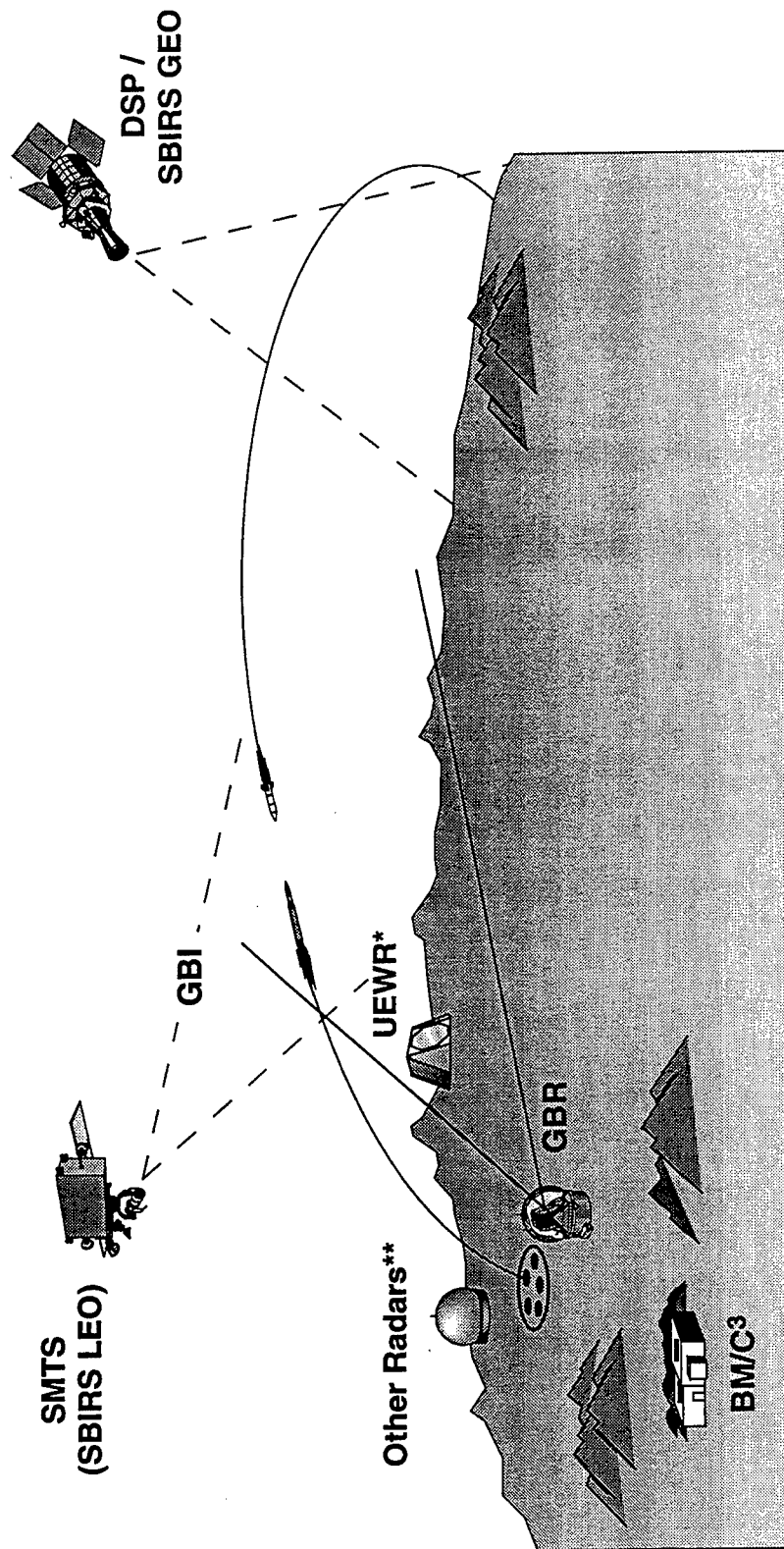
---







# NMD OBJECTIVE SYSTEM ARCHITECTURE



\* Necessary For Early Architecture, But May Be Used In Objective Architecture, Depending On Threat

\*\* Candidate Sensors

**Provides Defense Over The Assumed Range Of Existing And Potential Threats**





# **PASSIVE SENSOR**

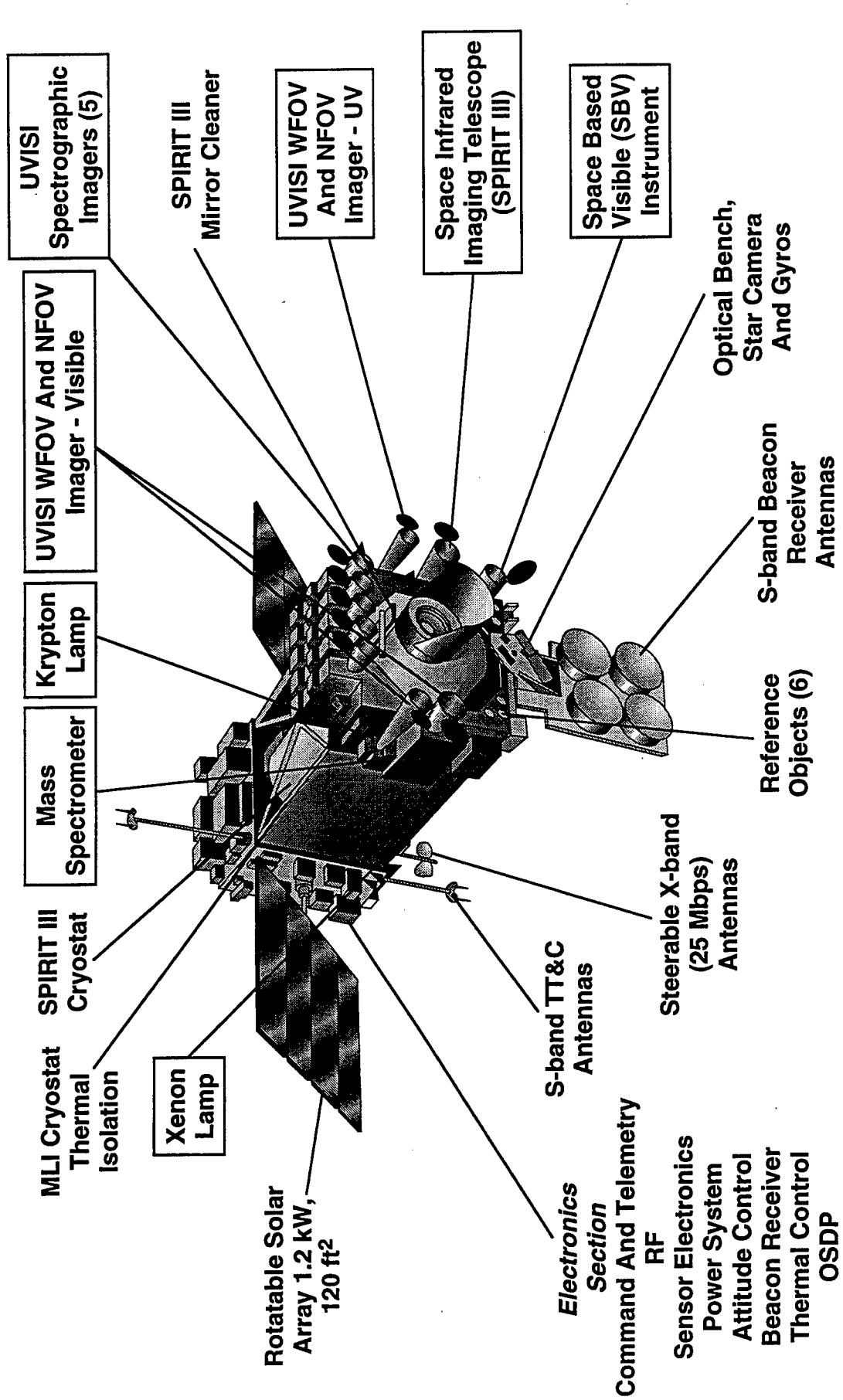
---

- **$\geq 2$  Color High Uniformity And Detectivity Focal Plane Arrays**
- **Long Life 30-65 K Cryocoolers**
- **Large Format Focal Plane Arrays For Increased Resolution**
- **Hyperspectral Focal Planes: IR, Visible, UV**
- **Cold Optics**
- **Uncooled Focal Plane Arrays**
- **Self-cleaning On Orbit For Contamination Control**





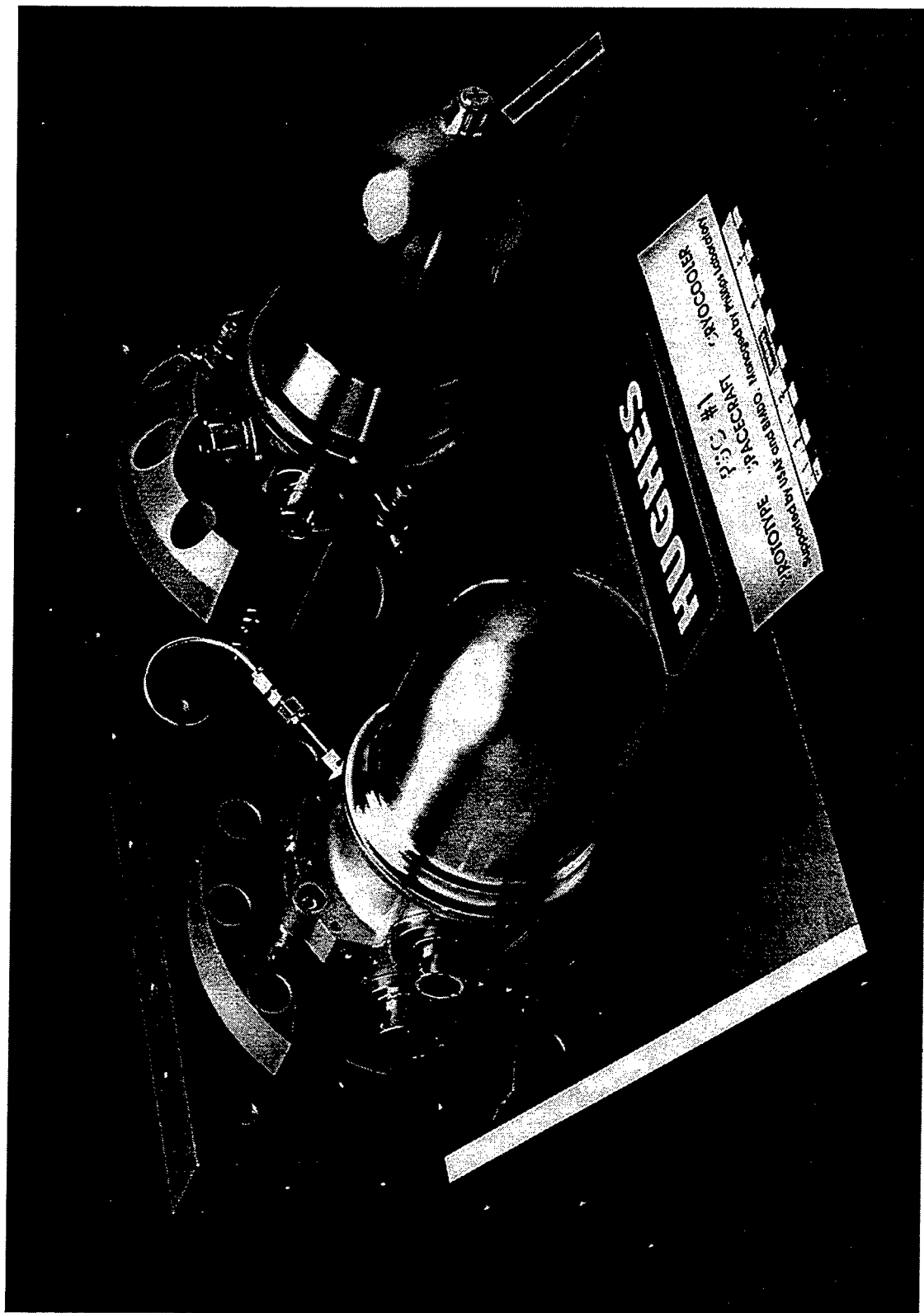
# MSX SPACECRAFT CONFIGURATION







# PROTOTYPE SPACECRAFT CRYOCOOLER







## ACTIVE SENSOR

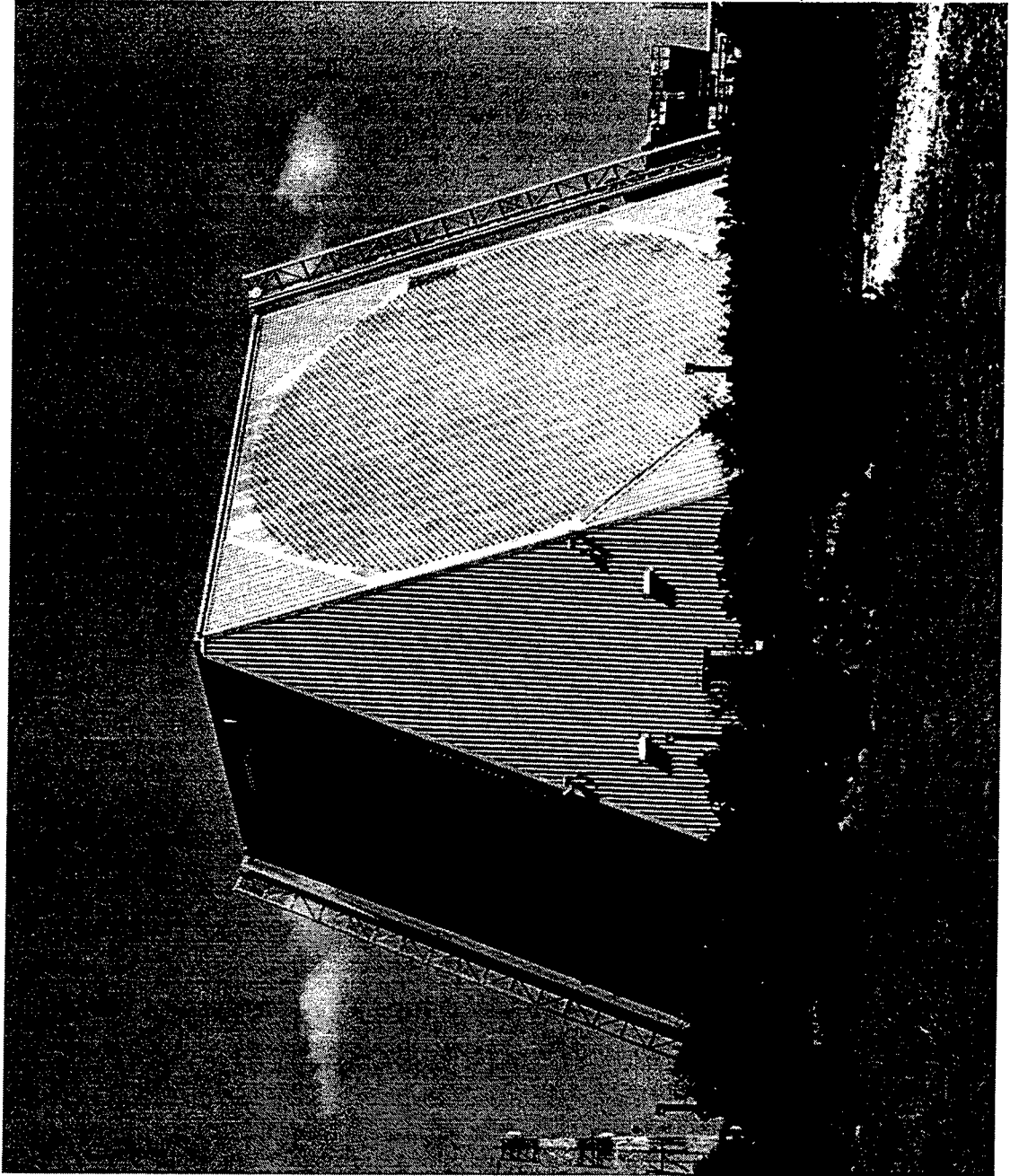
---

- High-power / Efficiency Solid-state Microwave T/R Modules
- Photonic Control Of Phased Arrays For Reduced EMI / Cross Talk
- Structurally Embedded, Composite, Or Thin / Thick Film Antenna
- Sparse / Aperiodic Wideband Array For Reduced Weight
- Fast Steering Arrays
- Wide Band Gap Semiconductors  $> 5.5$  eV
- Very Low Noise Amplifier
- Ultrastable Oscillator
- Diversely Polarized Elements
- Lightweight, High Efficiency Solid-state LADAR





# PAVE PAWS CAPE COD







# ELECTRONICS

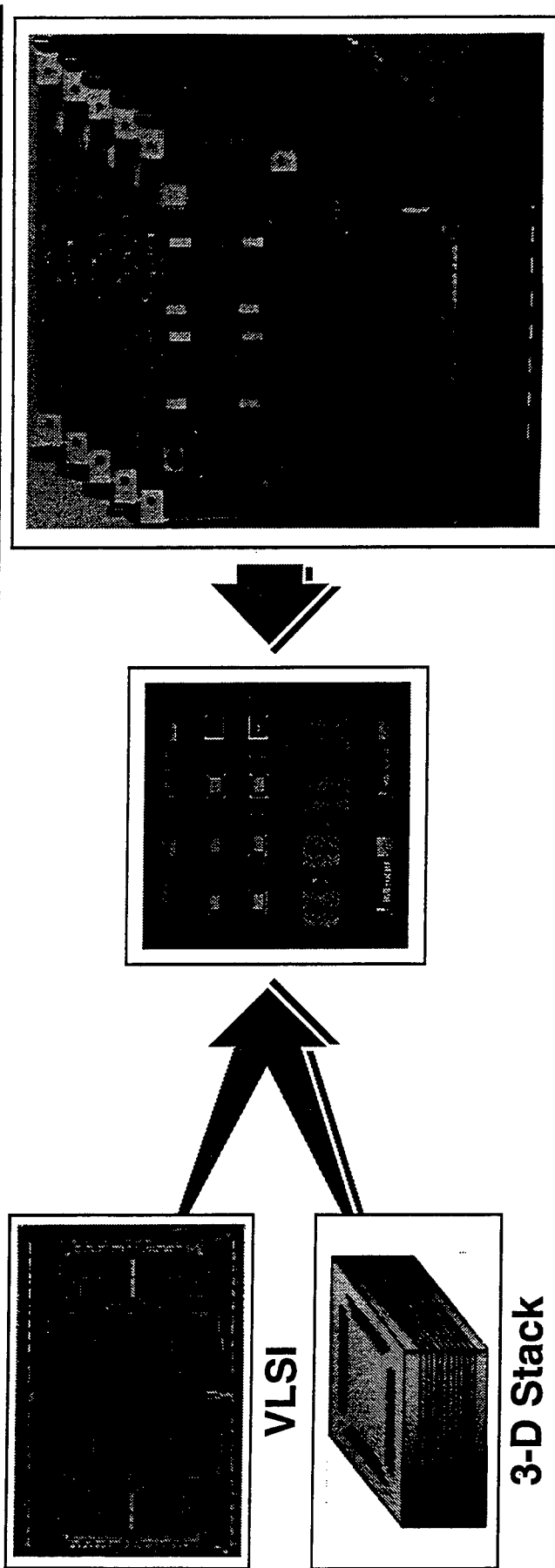
---

- **Sophisticated Phase Coded Waveform Generator / Receiver For Wide Instantaneous Bandwidth**
- **High-speed Signal Processing For Sophisticated Waveform**
- **On Element Signal Processing**
- **MMIC Low Input / High Output Power**
- **Very High-speed A / D And D / A Converters (> 12 Bits)**

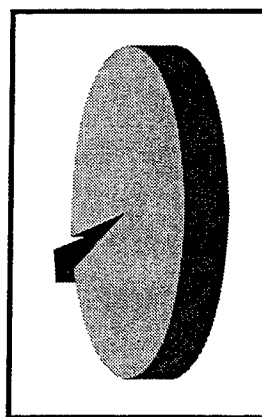




# MOSAIC ARRAY DATA COMPRESSION AND PROCESSING (MADCAP) TECHNOLOGY CONTRIBUTIONS

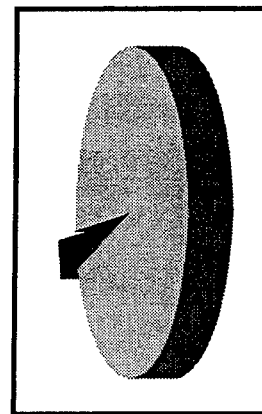


97% Reduction



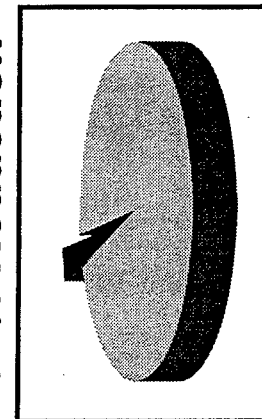
Volume

96% Reduction



Weight

97% Reduction



Power

**Payoff: Smaller Signal Processors And Sensor**





# ALGORITHMS

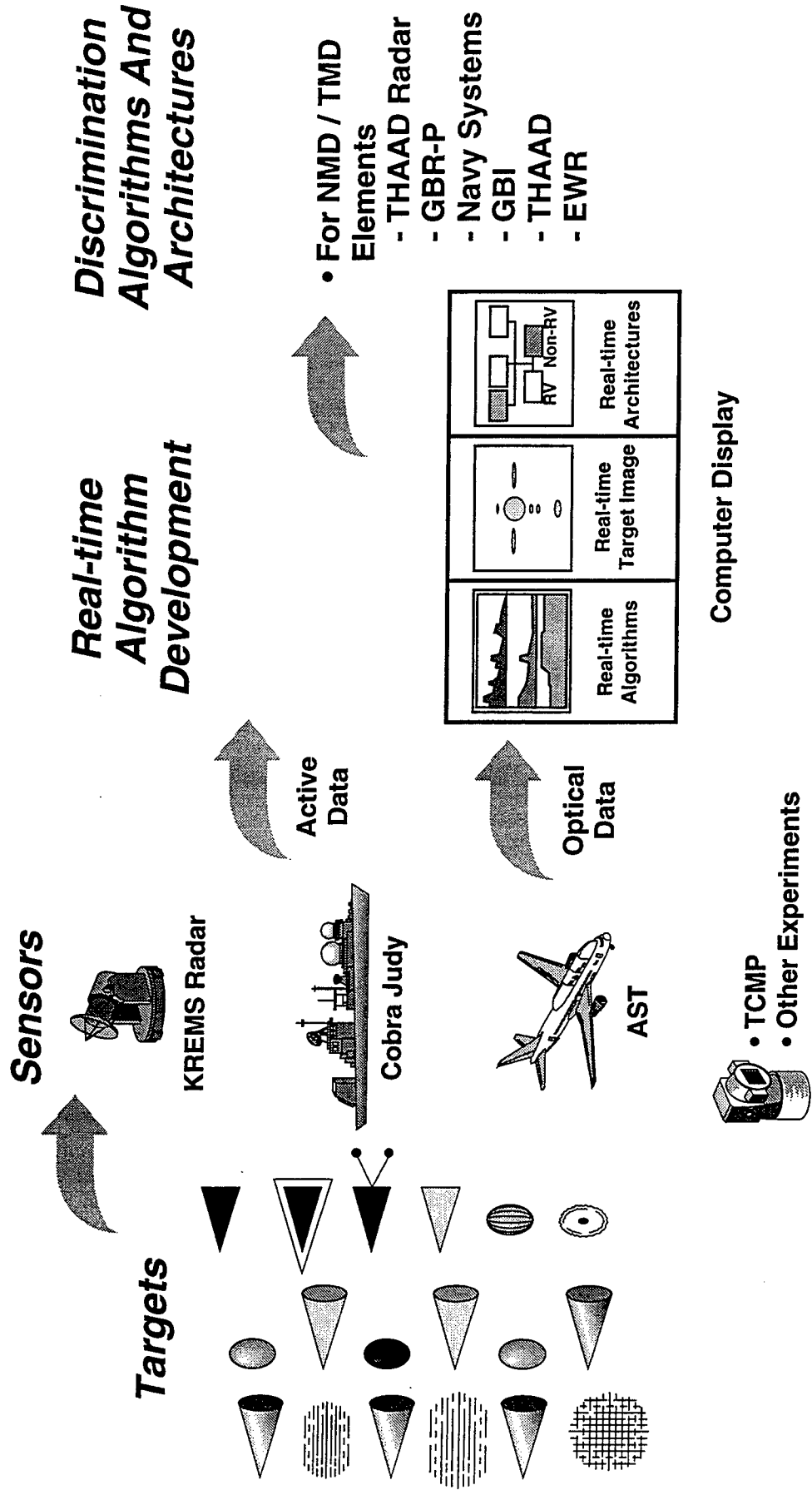
---

- Autonomous Target Recognition
- Integrated Real-time Discrimination
- Image Reconstruction
- Clutter Suppression Techniques
- High Background Noise Suppression
- Adaptive Signal Processing
- Near Real-time Optical Spectral Analysis
- Increased Doppler Resolution
- Real-time Sensor Fusion And Control
- Track Correlation
- Boosting Target Prediction
- Nonballistic Tracking
- Precision 3-D Tracking





# REAL-TIME DISCRIMINATION PROGRAM (PMA 1155)





# BM/C<sup>3</sup> Technology



April 1996

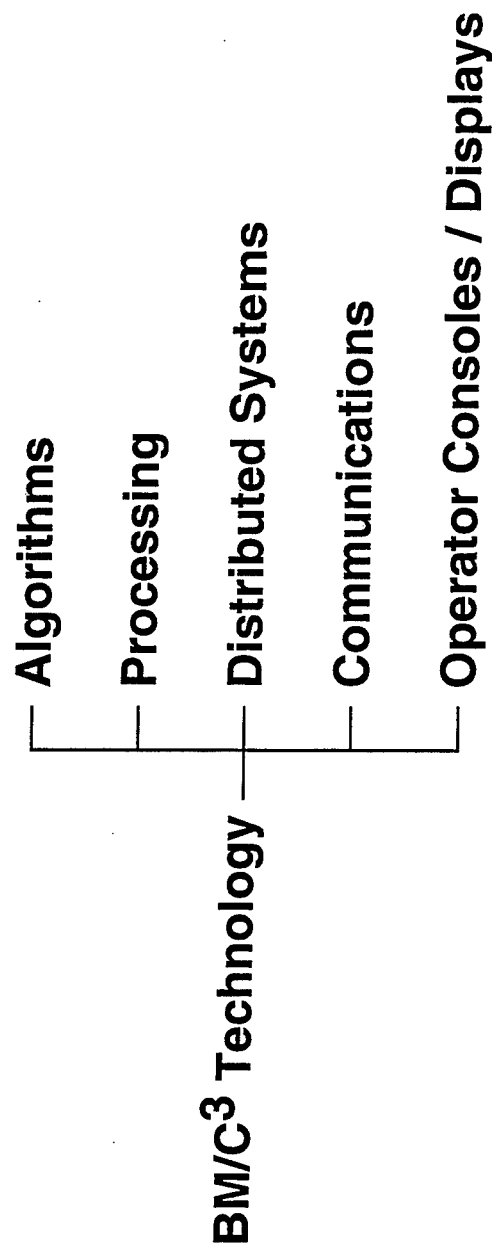
**Dr. Leslie J. Pierre**  
**Deputy Director, BM/C<sup>3</sup> Integration**  
**Technology Readiness Deputate**  
**Ballistic Missile Defense Organization**





# BM/C<sup>3</sup> TECHNOLOGY OVERVIEW

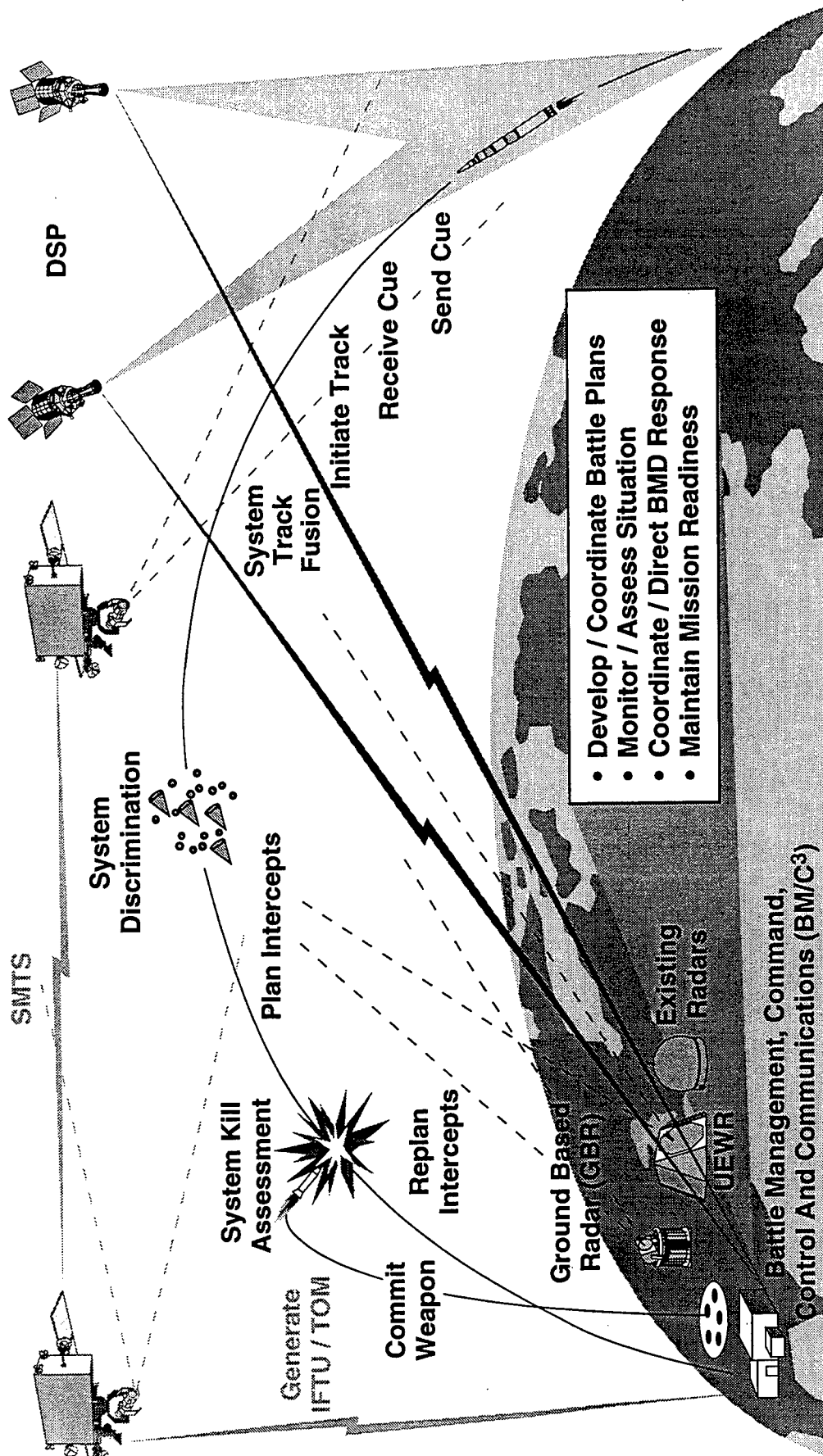
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# NMD BM/C<sup>3</sup> CHALLENGE



**Defense Against Strategic Ballistic Missiles**





# ALGORITHMS

---

- Tracking Of Responsive Or Maneuvering Threat
- Sensor And Data Fusion
- Discrimination
- Kill / Hit Assessment
- Battle Assessment
- Resource Management And Allocation
- Decision Support, Including Battle Planning Options
- Fault Tolerance And Error Control

**Real-time Adaptive Algorithms Needed For  
Surveillance And Distributed Engagement Planning**





# PROCESSING AND DISTRIBUTED SYSTEMS

---

- High-speed, Fault Tolerant, Reliable, Real-time Distributed Databases
- Synchronization And Control Of Distributed Databases
- Distributed Computing And Network Systems
- Massively Parallel Processors
- Tera-OPS Throughput Processors
- Data Compression Techniques





# **COMMUNICATIONS AND DISPLAYS**

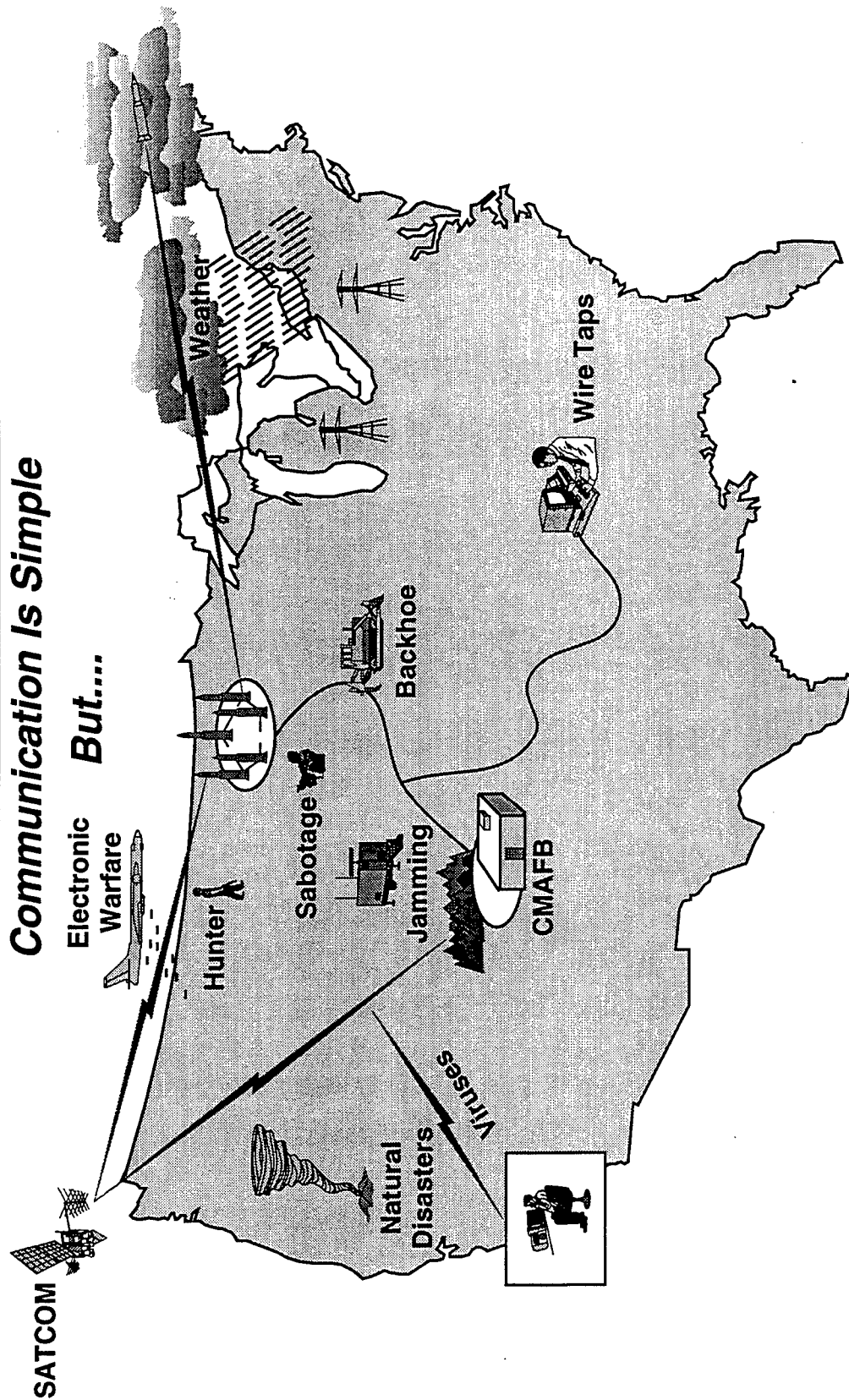
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- **Multigigabit Per Second Rate Communications**
- **Lasers And Optical Fibers**
- **Lightweight Conformable Antennas**
- **Image Transmission**
- **Network Reconstitution And Reconfiguration**
- **Human Oriented Visualization Technology**
- **Alternative Technologies For 3-D Volume Illumination And Display**
- **Distributed And Collaborative Decision Making Support**





# THE COMMUNICATIONS CHALLENGE



*Communication Is Simple*

*Electronic Warfare But....*

**NMD Imposes Near Perfect Performance  
In A Complex Environment**



# Program Briefing To Industry and Government

9 April 1996

## Narrative of Briefings for Security and Policy Review

### BM/C<sup>3</sup>

#### Page 1 of TRB Package: Cover

#### Page 2 of TRB Package: BM/C<sup>3</sup> Technology Overview

This chart is a simple tree diagram showing the five primary technology areas of interest for BM/C<sup>3</sup>, which are discussed in greater detail in subsequent charts:

- Algorithms: Advanced algorithms for tracking, data fusion, and battle management, emphasizing real-time, adaptive fault tolerant.
- Processing: High throughput, highly reliable, massively parallel processors
- Distributed Systems: Integrated, real-time wide/local area networks operating on large shared databases
- Communications: Reliable, high data rate, secure communications
- Operator Consoles/Displays: Standardized, intuitive decision support

**Page 2a:** Graphic entitled "NMD BM/C<sup>3</sup> Challenge" which describes with words and pictures the many elements of a NMD architecture which must be coordinated and the functions which must be performed.

#### Page 3 of TRB Package: Algorithms

This chart lists the top technology interests for BM/C<sup>3</sup> algorithms:

- Tracking of Responsive or Maneuvering Threat: This threat evolution would necessitate more robust tracking and battle planning
- Sensor and Data Fusion: Provides more robust, enhanced tracking, discrimination, and kill/hit assessment
- Discrimination: Enhanced system performance can be obtained if BM/C<sup>3</sup> can fuse sensor data to improve discrimination
- Kill/Hit Assessment: Robust, phenomenology-based kill/hit assessment algorithms support battle planning options and resource allocations
- Battle Assessment: Adaptable, real-time assessment of system performance
- Resource Management and Allocation: Optimization of resources, especially important as evolving threats push performance envelopes of sensors and interceptors
- Decision Support, Including Battle Planning Options: Real-time, options planning and evaluation to support rapid decision making
- Fault Tolerance and Error Control: Reliable techniques for minimizing the effects of errors and faults



## **Page 4 of TRB Package: Processing and Distributed Systems**

This chart lists the top technology interests for BM/C3 processing and distributed systems:

- High-Speed, Fault-Tolerant, Reliable, Real-Time Distributed Databases
- Synchronization and Control of Distributed Databases: Maintain current and accurate large real-time, changing database over a wide area network
- Distributed Computing and Network Systems: Reliable and fault/error tolerant
- Massively Parallel Processors: To support data intensive functions such as track and discrimination
- Tera-Ops Throughput Processors: To support more capable options development, data fusion, and resource management
- Data Compression Techniques: To reduce processing loads without loss or degradation of fidelity

## **Page 5 of TRB Package: Communications and Displays**

This chart lists the top technology interests for BM/C3 communications and displays:

- Multi-Gigabit Per Second Rate: Increase data rate transmission to provide efficient delivery of messages and support increased processing and performance. Supports rapid transmission for track processing discrimination and other data intensive processing requirement.
- Lasers and Optical Fibers: Improved data rate transmission using coherent wave forms, and OPINE capability that is inherently survivable and can communicate through NWE with immunity to EMP bursts.
- Image Transmission: To support display of images to enhance human interface at work stations
- Network Reconstitution and Reconfiguration: Supports communication connectivity of battle plan execution without interruption by hardware failure or decapitation of command while executing the BMD mission. Provides effective means of fault tolerance and error control.
- Human Oriented Visualization Technology: Enhance user friendly and operational flexibility.
- Alternative Technologies for 3-D Volume Illumination and Display: Supports look ahead battle planning and real-time, adjustable engagement planning and control.
- Distributed and Collaborative Decisionmaking Support: Provide real-time conferencing and live interaction of commands and control.

**Page 5a:** Graphic entitled "The Communications Challenge" which describes with words and pictures the difficulties which must be overcome to support the NMD BM/C3 task.







(4)

# **Small Business Innovation Research**



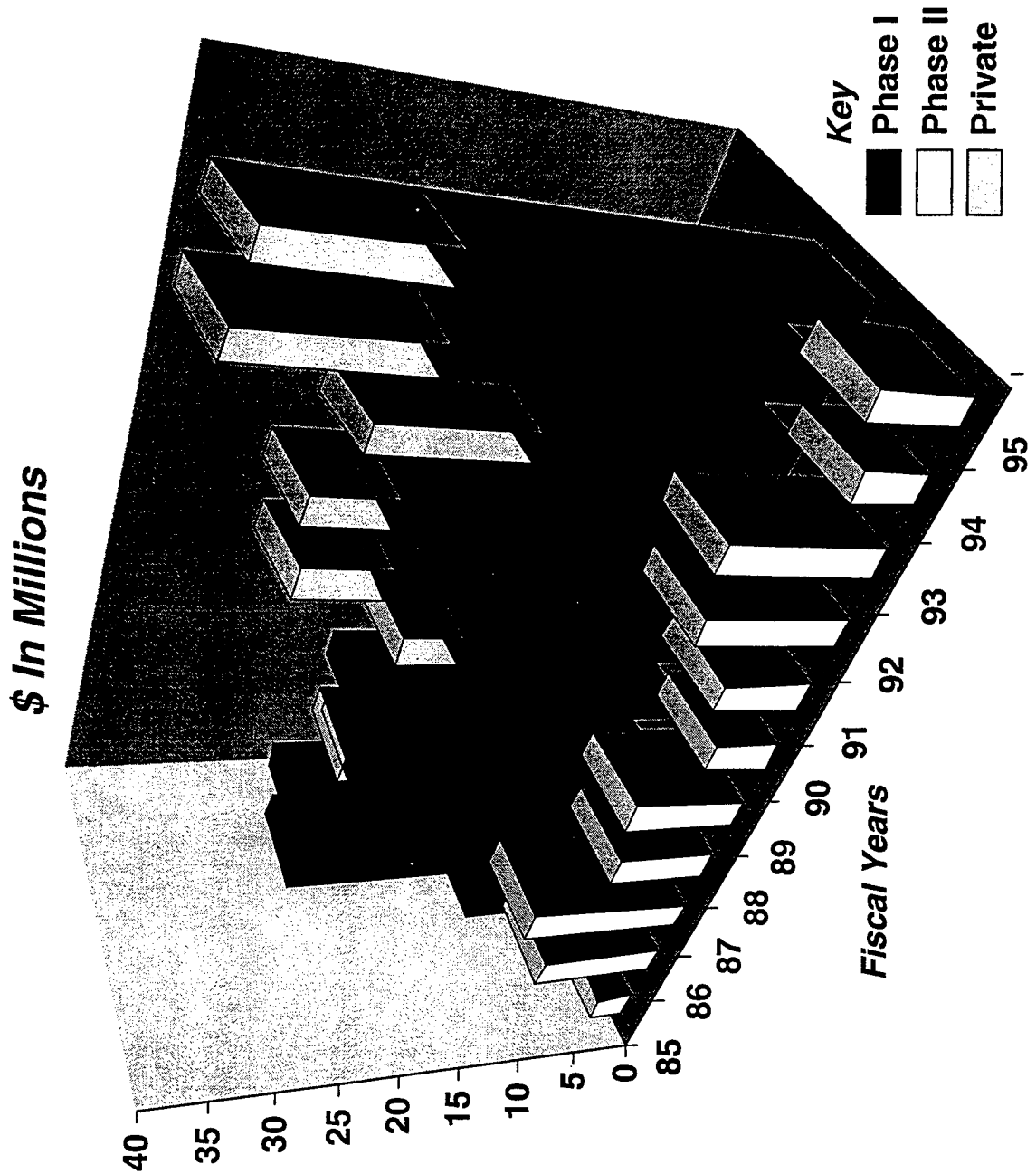
**April 1996**

**Mr. Guy Hammer  
Technology Readiness Deputate  
Ballistic Missile Defense Organization**





# BMDO SBIR FUNDING







# SELECTION CRITERIA

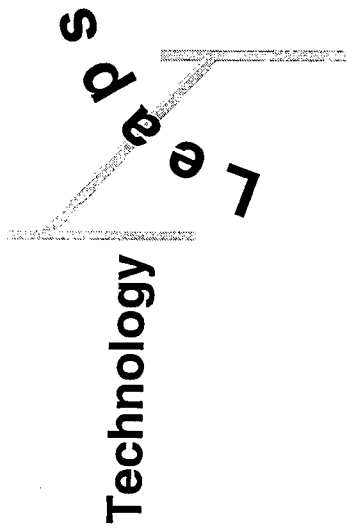
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- ☒ New ! New ! New !
- ☒ Helps BMDO
- ☒ Future Market





# SBIR



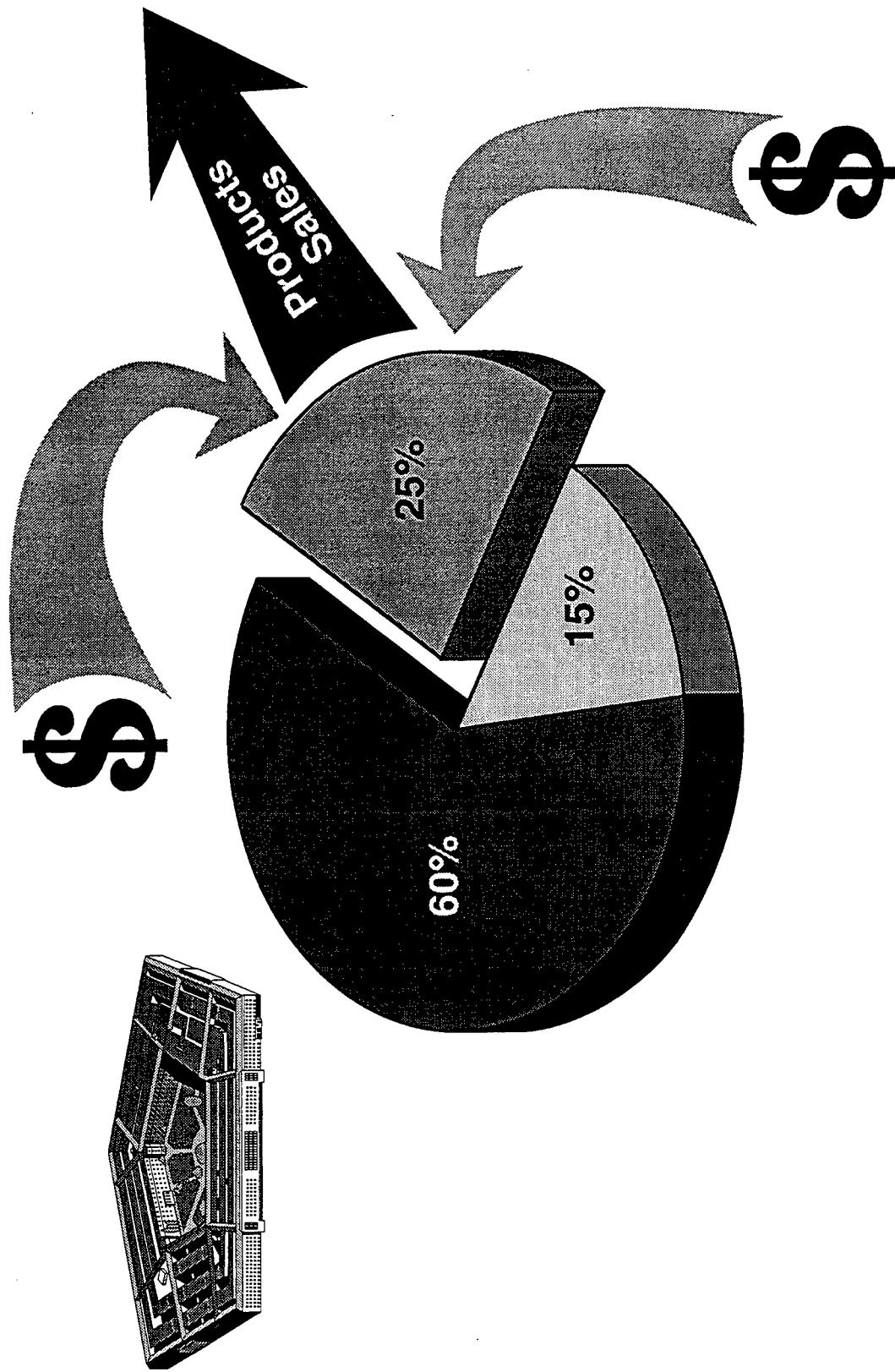
- Light
- Fast
- Small
- Reliable
- Durable
- Low Power

Think  
Performance  
Per Pound





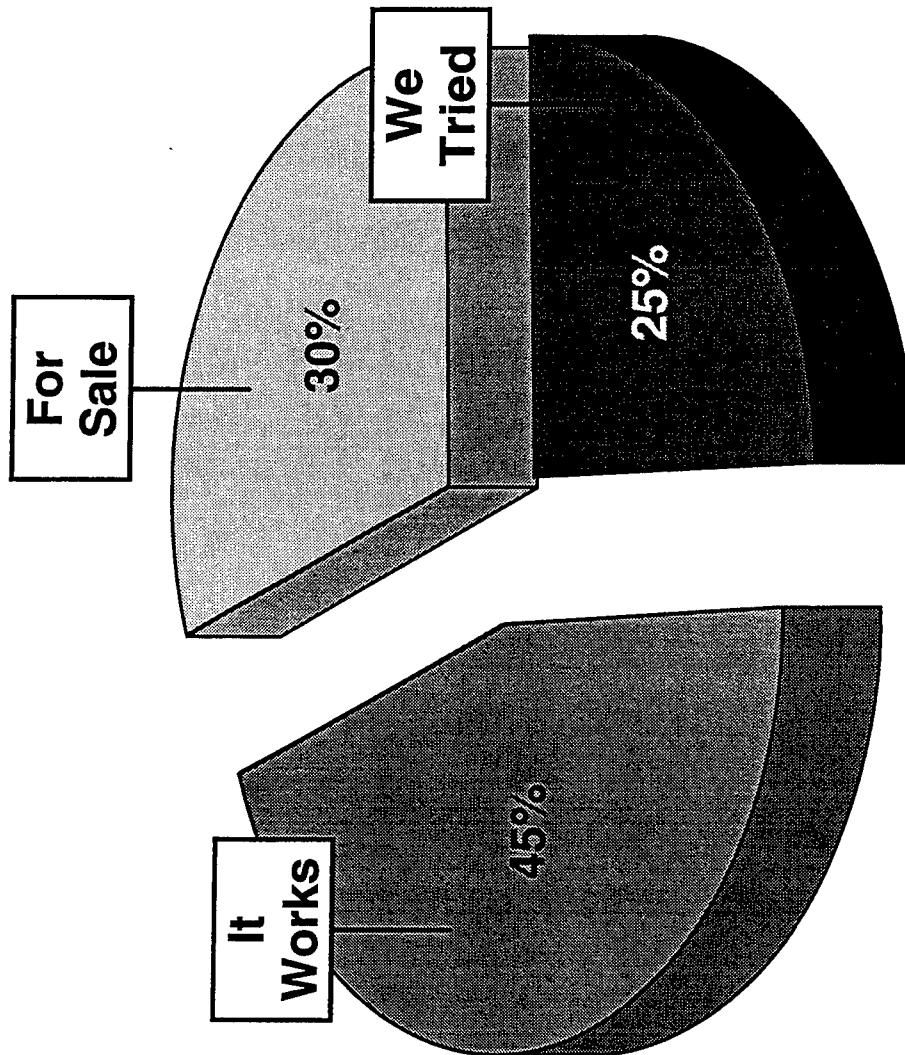
# SBIR RESULTS







## 1994 - 1995 RESULTS







# RESULTS

---

- **10 Firms Got \$140 Million Initial Public Offerings**
- **Employment Up 48%**
- **30%++ Got Private Capital**





## HOW TO FIND US

---

### ***DoD 800-DOD-SBIR***

- DoD SADBUD: 703-697-1481

### ***BMDO 800-937-3150 (Administration)***

- Office: 703-604-0145
- Modem: 800-WIN-BMDO
- World Wide Web: <http://www.futron.com/bmdo/sbir.html>
- Internet: [Telnet sbaonline.sba.gov](http://Telnet.sbaonline.sba.gov)



# Program Briefing To Industry and Government

9 April 1996

## Narrative of Briefings for Security and Policy Review

### **Small Business Innovative Research (SBIR)**

#### **Page 1 of TRI Package: Cover**

#### **Page 2 of TRI Package: BMDO SBIR Funding**

The chart shows bargraphs of the funding levels for Phase I, Phase II, and Private investments each year since 1985. What started off as primarily BMDO funding has now grown to be largely private funding. BMDO investment has remained relatively constant over the period, while overall investment has increased significantly.

#### **Page 3 of TRI Package: Selection Criteria**

The selection criteria are relatively simple in concept. Technologies are sought which are new and innovative. They need to have some benefit to BMDO. And they need to have a potential future market in order to get matching funding from private industry. Beyond these criteria, the candidate technologies are prioritized from technical evaluations and funding is provided to the top candidates until the money is gone.

#### **Page 4 of TRI Package: Technology Interests**

The technical objectives of the SBIR programs include: high performance per pound, reliability, durability, low power, lightweight, smaller, faster, cheaper, etc.

#### **Page 5 of TRI Package: SDI SBIR Results**

Since its inception, the SBIR program has resulted in about 25 percent of the investments surviving to the point of products on the market. About 60 percent of the investments were successful programs that await adoption, and about 15 percent were not successful.

#### **Page 6 of TRI Package: 1994-1995 Results**

The most recent year of activity in SBIR programs has surpassed the SDI historical results described in the previous chart. During the past year, roughly 30 percent of the programs made it to market for sale. Of the remaining 70 percent, 45 percent were successful and 25 percent were not successful.

#### **Page 7 of TRI Package: Results**

During the most recent year, 1994-1995, ten of the firms received \$140 million in Initial Public Offerings. Also, employment increased by 48 percent. Finally, more than 30 percent received private capital.

#### **Page 8 of TRI Package: How to Find Us**

This chart just shows the phone numbers and internet/worldwide web addresses for any one interested in participating in the program or getting more information.







# BAA Description



April 1996

Col William C. Smith, USAF  
Sensor And Phenomenology Technology Directorate  
Technology Readiness Deputate  
Ballistic Missile Defense Organization





## BAA PLAN

---

- FY 97 Funds
- Individual Awards \$150-\$500K
- Total Funding Approximately \$3-4M
- Cost Shared: 50% BMDO, 50% Industry
- Detailed BMDO Technology Needs Briefing To Industry
  - 9 JUL 96
  - ANSER Corporation Facility In Arlington, VA
- BAA In CBD Around Mid August 1996
- Two-step Proposal Review Process
  - White Papers (5 Page Limit)
  - Down Select White Papers For Detailed Proposals (25 Page Limit)



# National Missile Defense Program



April 1996

Col David McNierney, USAF  
Assistant Deputy / NMD Readiness  
Technology Readiness Deputate  
Ballistic Missile Defense Organization





# OUTLINE

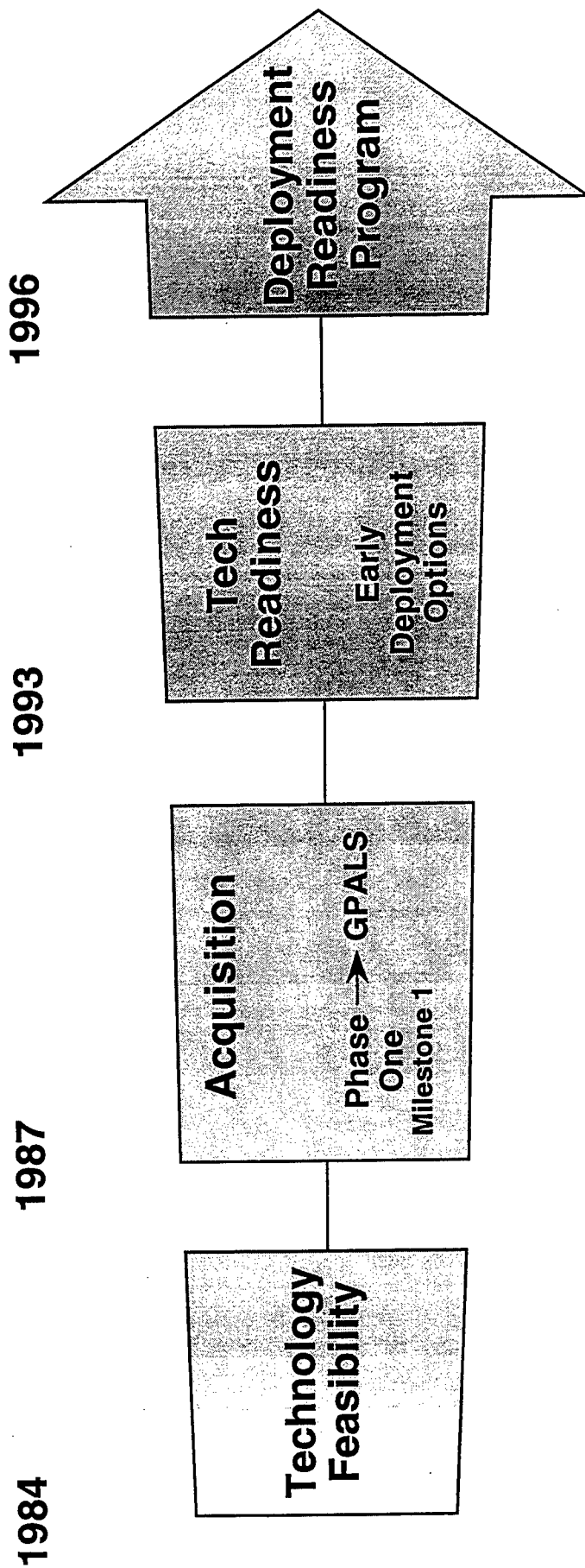
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- NMD: Past, Present, Future
- NMD Program Elements
- Industry Opportunities





# NATIONAL MISSILE DEFENSE EVOLUTION

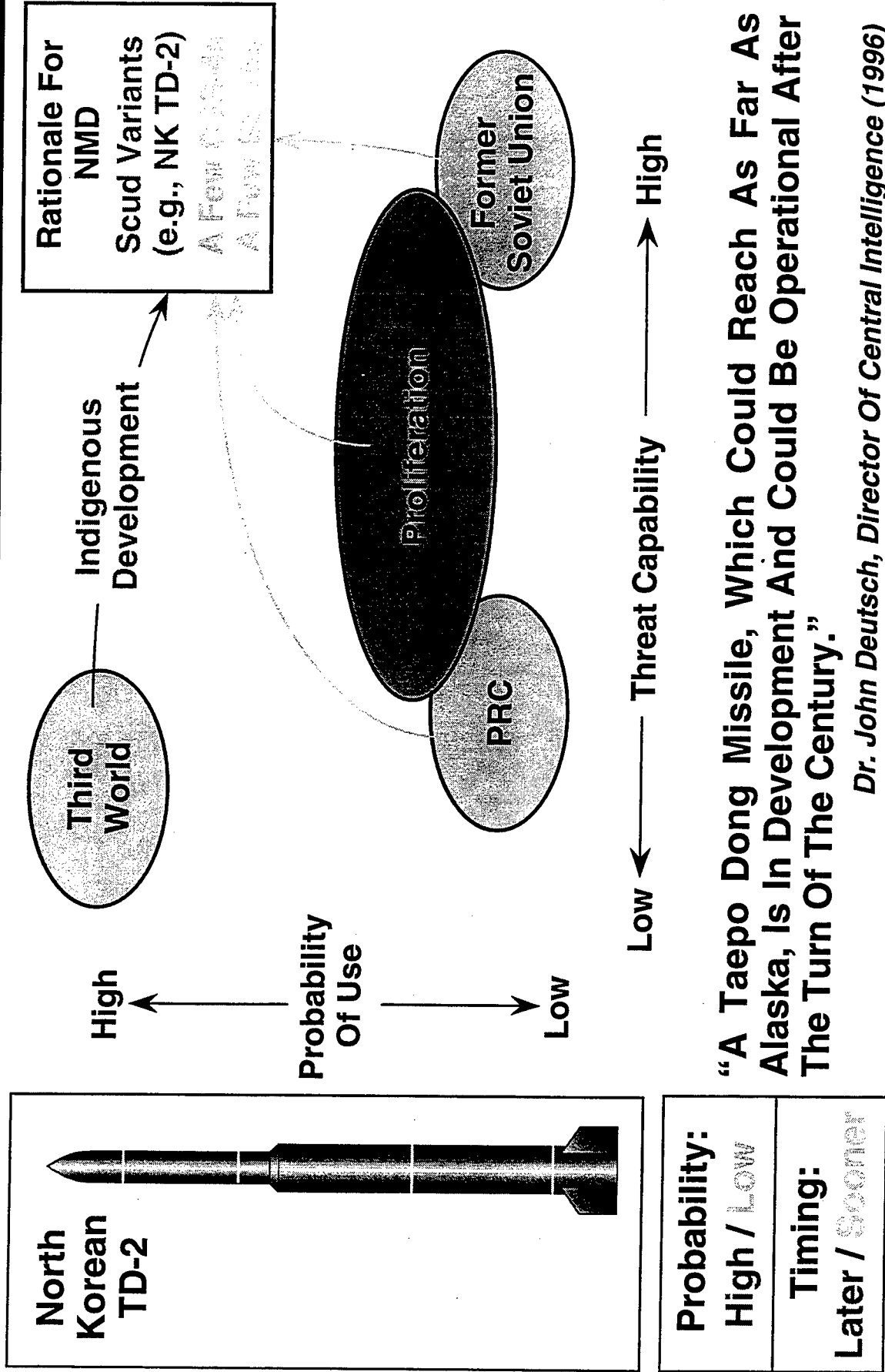


- The NMD Program Provides A Hedge Against The Emergence Of A Future Ballistic Missile Threat To The U.S.





# THREAT CHARACTERISTICS

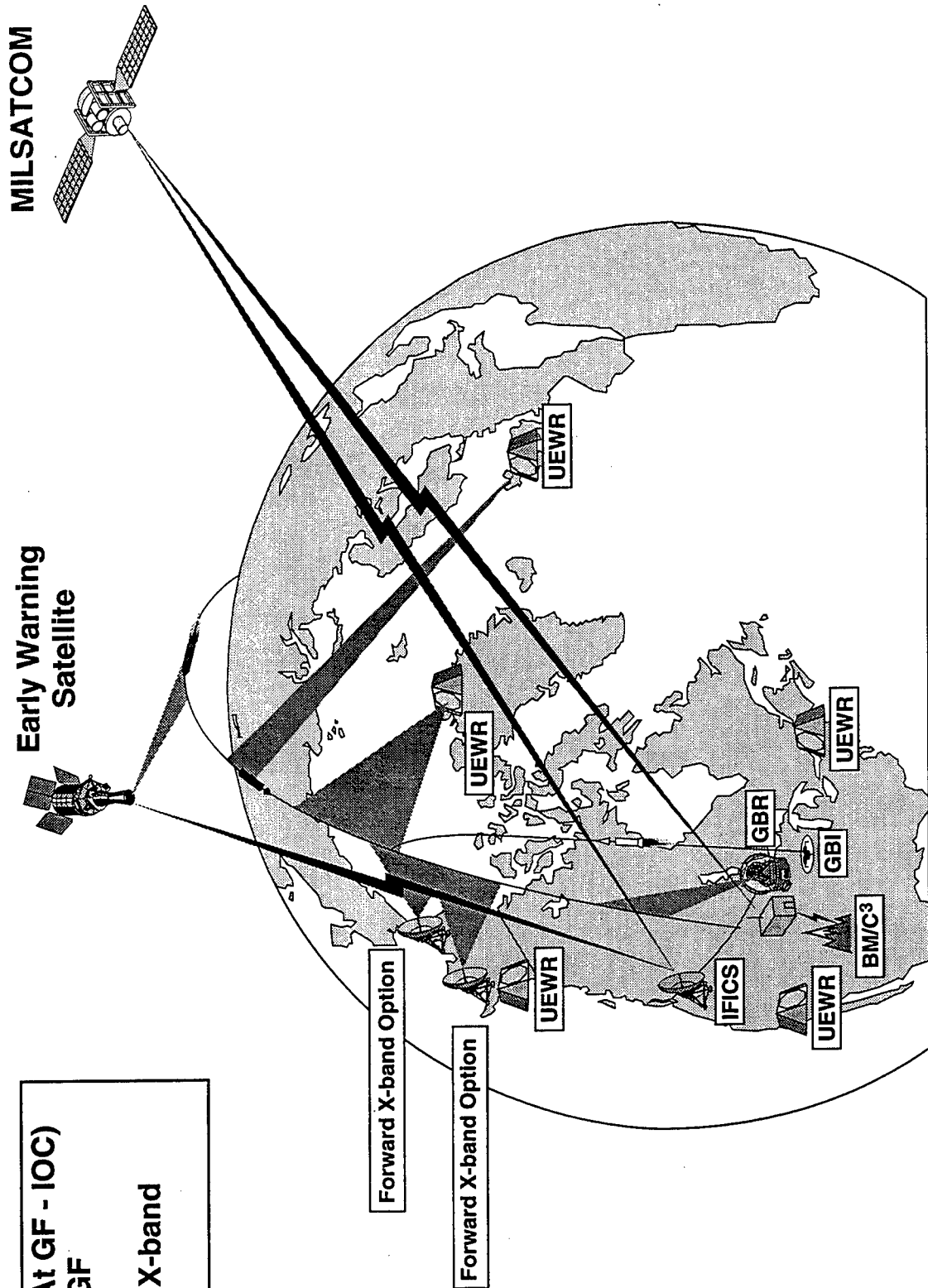






# SINGLE SITE NMD ARCHITECTURE OPTION ("3+3")

- GBI (20 At GF - IOC)
- GBR At GF
- UEWRs
- Forward X-band
- BM/C<sup>3</sup>

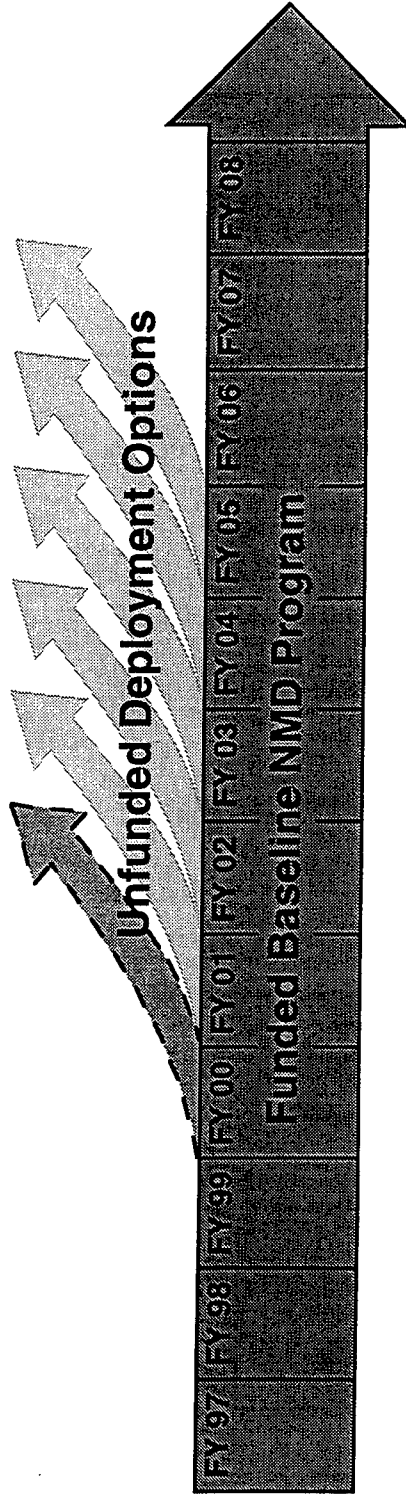






# NMD DEPLOYMENT READINESS

- Goal / Requirement
  - Position The U.S. To Respond To Strategic Missile Threat As It Emerges With A Leak Proof Defense



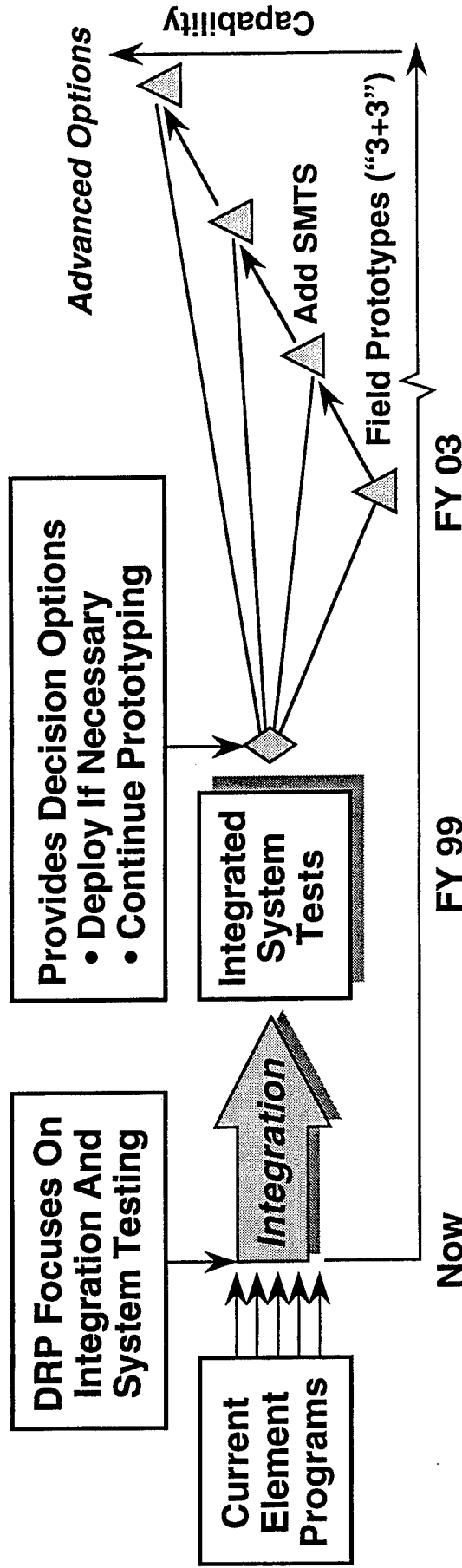
- Shift Emphasis From Technology To Deployment Readiness -- But No Commitment To Deploy Now
- Develop Within 3 Years, Elements Of An Initial NMD System, That Could Be Deployed Within 3 Years Of A Decision
- Deployment Options Will Be Triggered By The Threat





# DEPLOYMENT READINESS PROGRAM

## *An Evolutionary Acquisition Concept*

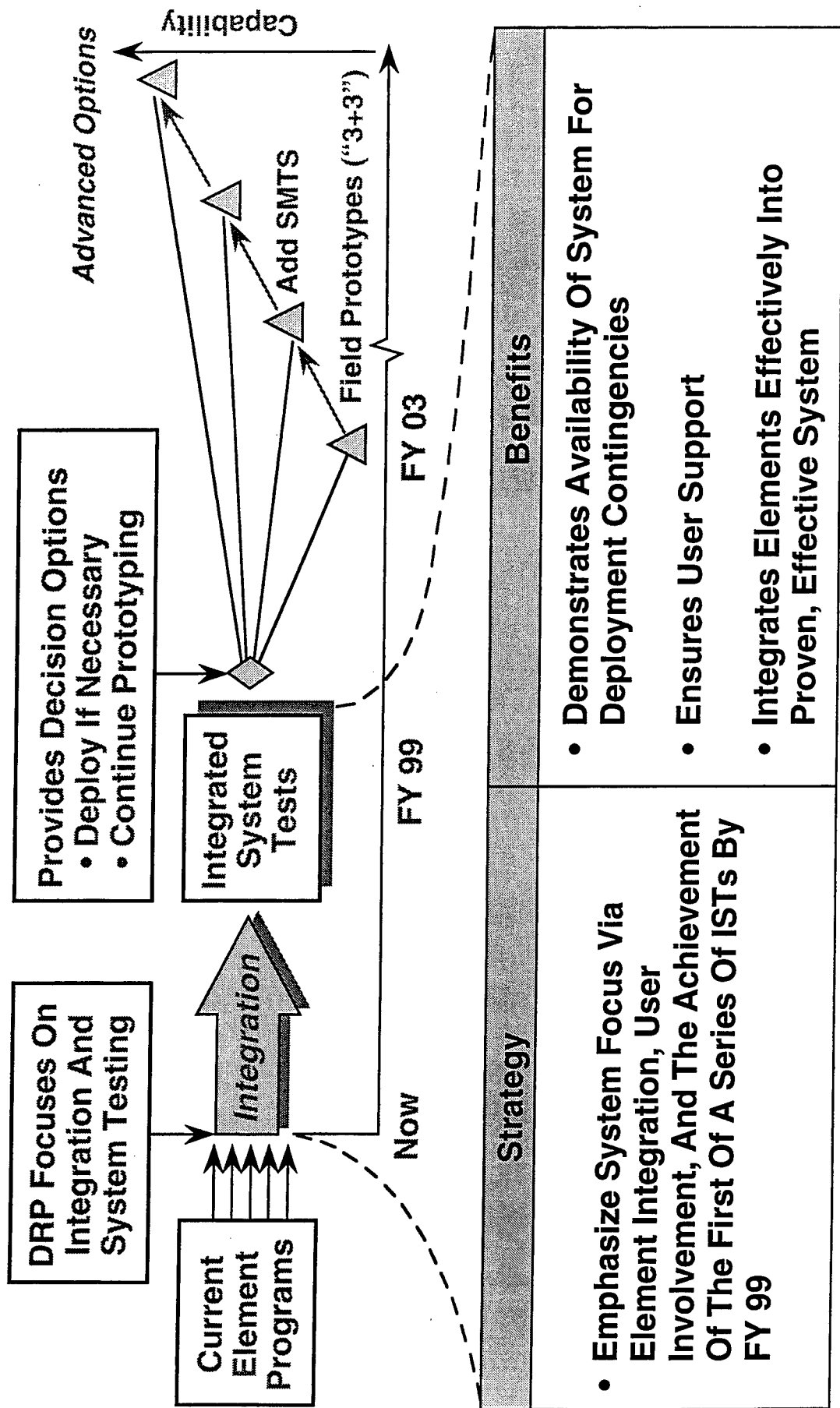


- Evolutionary Acquisition Cycles Through Integration / System Testing
- Demonstrates Technology At Component, Element, And System Level
- Provides And Sustains Technology As A Hedge Against Advanced Threats
- Defers Commitment To Deployment Until
  - A Clearly Defined Threat Is Identified
  - Alternative Responses Have Been Considered
- Moves To Fielding When Mandated By Threat





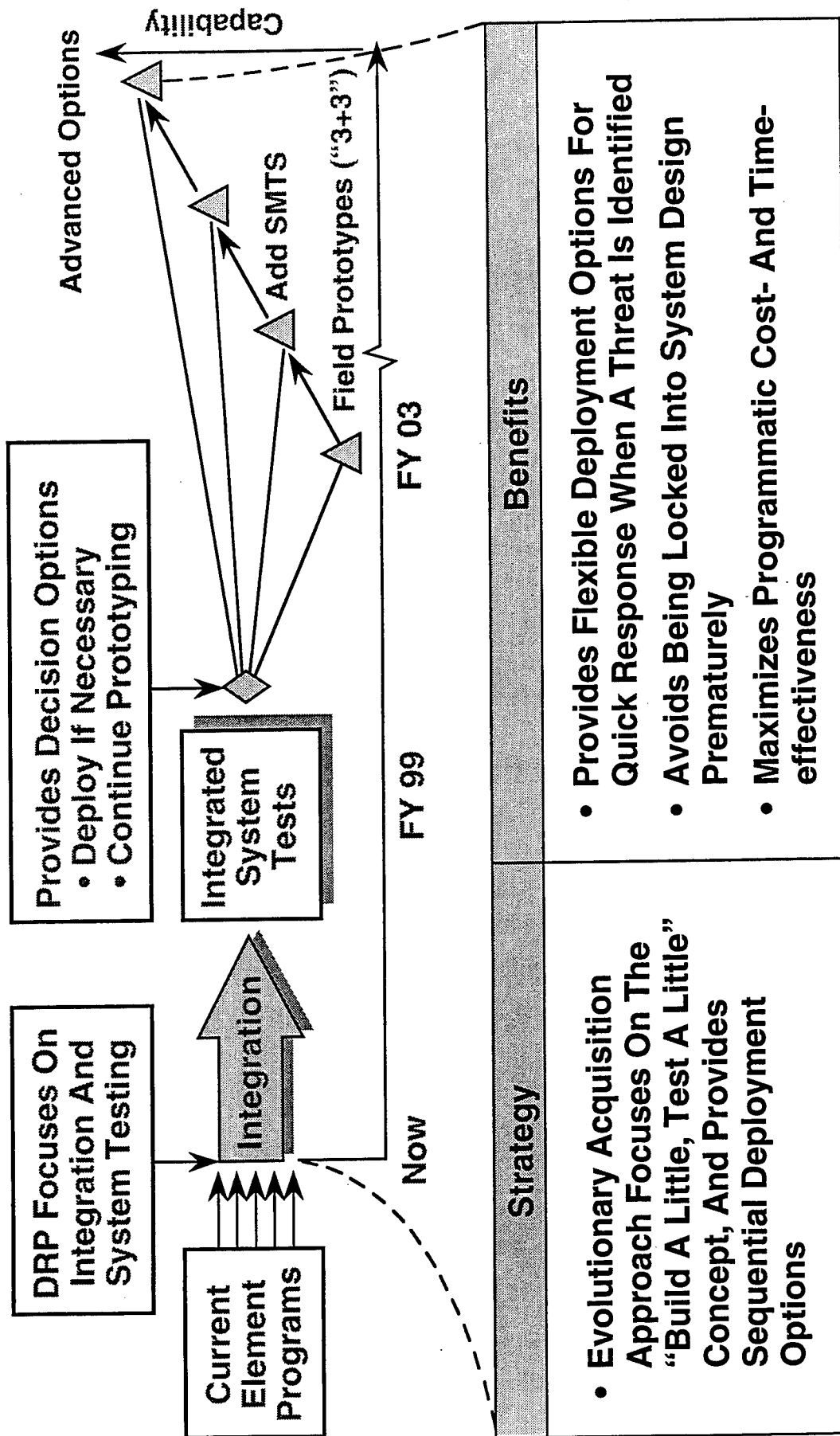
# NEAR TERM BENEFITS







# LONG-TERM BENEFITS







# PROGRAM CHARACTERISTICS

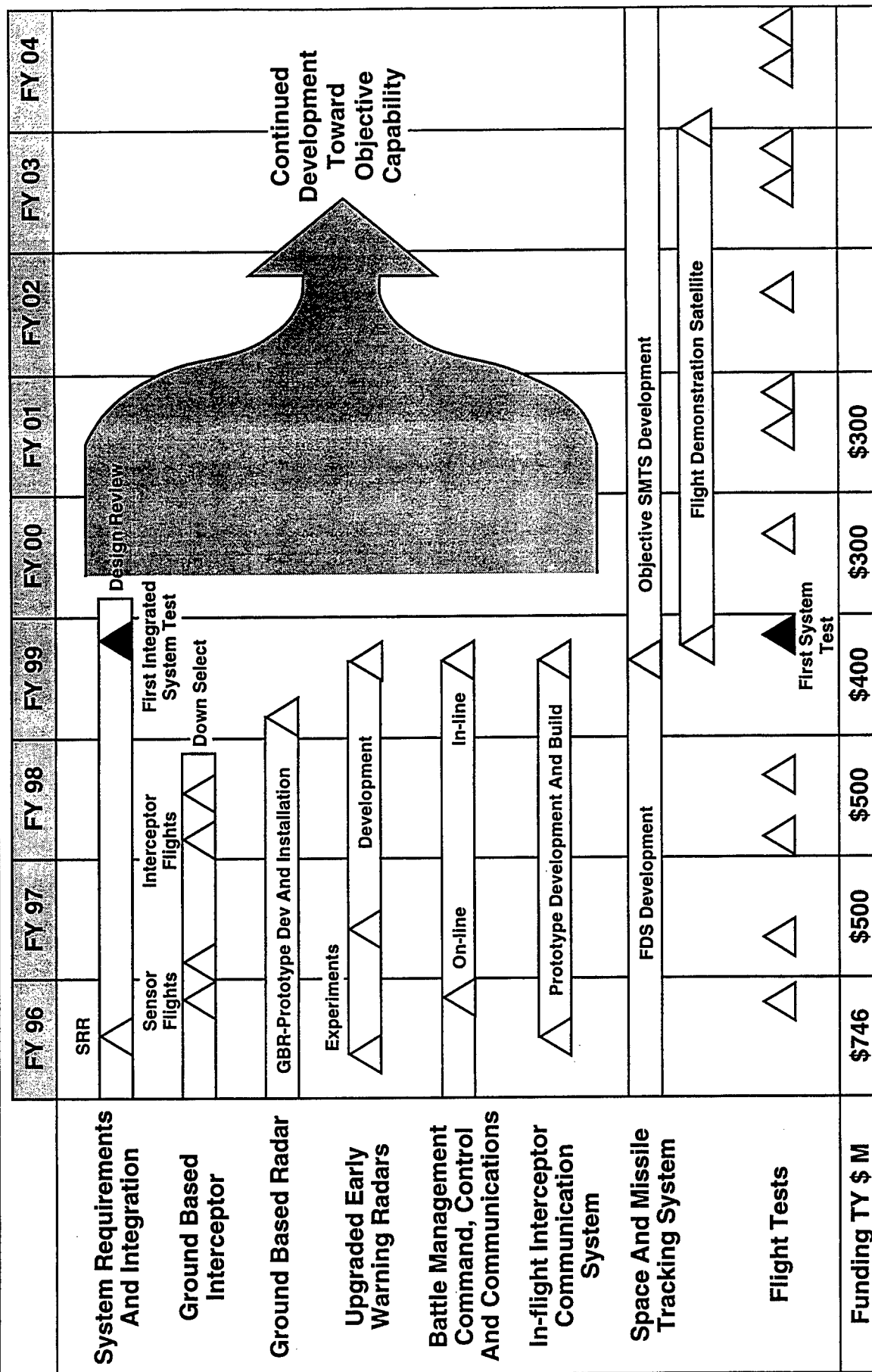
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- **Emphasize Strong System Focus To Ensure Cost And Operationally Effective**
  - Integration Of All NMD Elements (Including SBIRS)
  - Interoperability For Strategic Cruise Missile Defense
  - Flexibility Of Response Against The Full Range Of Threats
- **Coordinated / Balanced Element Development To Achieve First Integrated System Level Test By 1999**
  - Establishes Early Deployment Option (3+3) As A Hedge Against Unforeseen Threats
  - Services Develop Elements With BMDO Providing System Integration And BM/C<sup>3</sup> Development
- **Builds On Strong Synergy With TMD To Reduce Cost And Risk**





# NATIONAL MISSILE DEFENSE PROGRAM







## **NMD EFFORTS REQUIRING ADDITIONAL EMPHASIS**

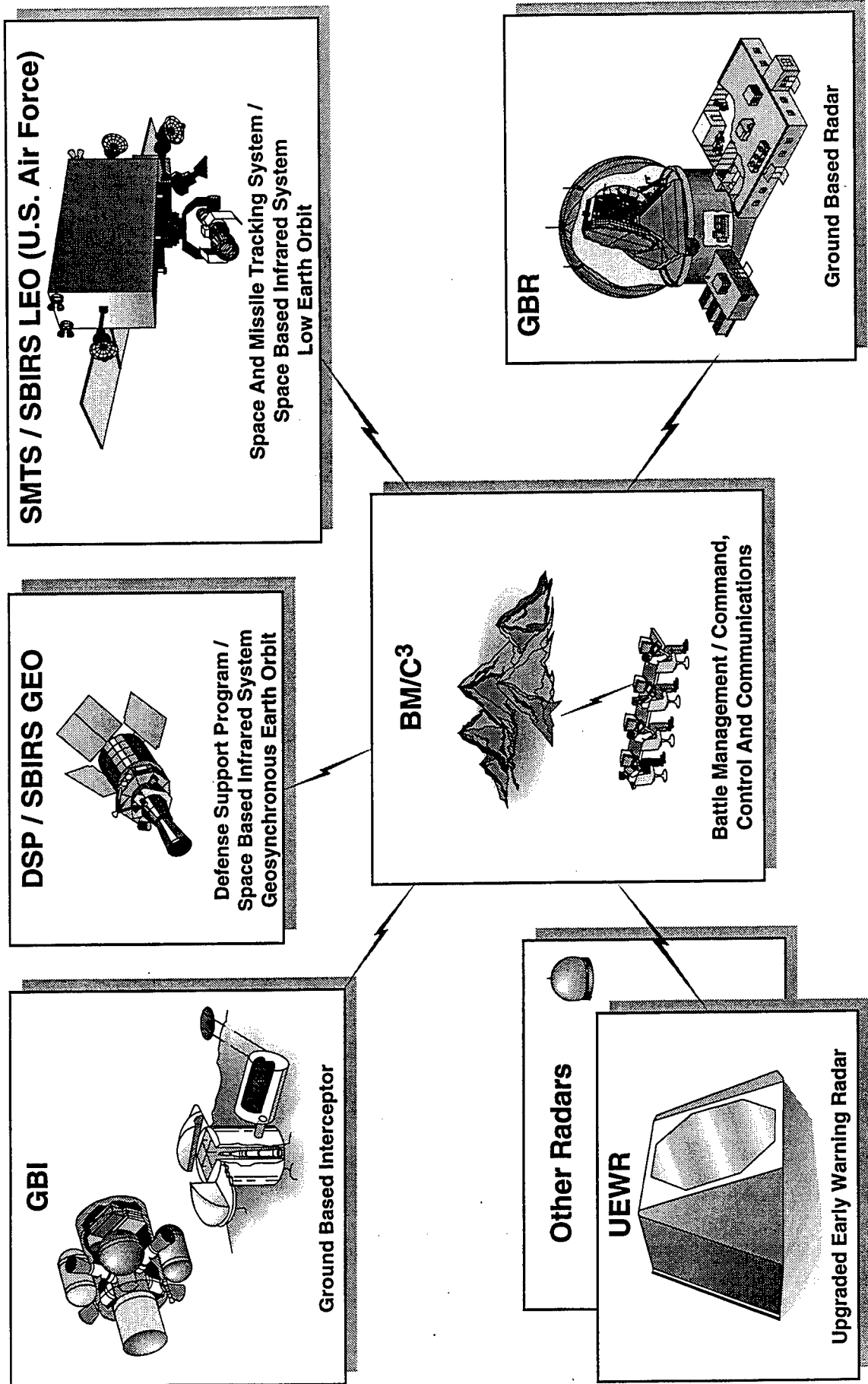
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- Accelerate New Booster Development For FY 99 Integrated System Test Availability
- Buy Additional Hardware To Eliminate Single Point Failures
  - EKV Hardware, Booster, Target Spares
- Perform Hardness Testing Of EKV's
- Add Two Flight Tests To Schedule For System Confidence
- Add Dedicated Radar Test Target
- Restore GBI Target's Competition
- Add Robustness To C2 Simulations / Develop System Exerciser
- Increased Element "Illities" Planning And Design Efforts
- Schedule Margin / PM Reserve (4%)
- SMTS Schedule Acceleration (FY 02 Launch)
  - USAF Funded





# THE NMD SYSTEM ELEMENTS







## ELEMENT PRIME CONTRACTORS

---

• GBI (EKV Contracts) <ul style="list-style-type: none"><li>- Hughes</li><li>- Rockwell</li></ul>	1990 Award Risk Reduction 3Q FY 94 D/S 1
• GBR (Family Of Radars Contract) <ul style="list-style-type: none"><li>- Raytheon</li></ul>	4Q FY 92 Award 3Q FY 94 RTD Mod
• BM/C <sup>3</sup> / SE&I / IFICS (IFICS Unfunded) <ul style="list-style-type: none"><li>- TRW</li></ul>	8/95 Award
• SMTS (BE Dem / Val Contracts) <ul style="list-style-type: none"><li>- TRW (Flying)</li><li>- Rockwell (Non-flying)</li></ul>	12/92 Award 4Q FY 94 D/S 1



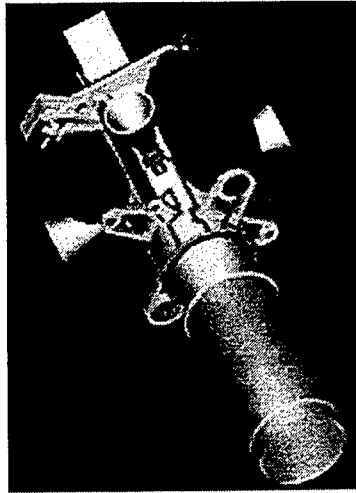


# GBI CONTRACTING STRATEGY

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- Program Builds On Past Successes
- Existing Competitive EKV Contract Vehicles Support Early Milestones
  - Rockwell And Hughes On Contract Since FY 91 To Provide KV Improvements Over ERIS
  - Both Seekers Will Be Flown In FY 96 / 97
  - Both Kill Vehicles Will Fly In FY 98
  - Down Select To One Contractor After FY 98 Fly Off
- Payload Launch Vehicle
  - Lockheed Martin Selected For Launch Vehicle And Integration Based On ERIS Success
- Competition For Booster And / Or Integrating Prime In FY 97 Reduces Risk
  - Approach TBD

Hughes Aircraft Co.  
Tucson, AZ



Rockwell International  
FY 96 Downey, CA







# **GBR CONTRACTING STRATEGY**

---

- **Modified Competitively Won Family Of Radars Contract To Implement The GBR-P**
  - **Leverage From TMD Production Lines (T/R Modules, TREAs, Cooling)**
  - **Utilize Same Signal And Data Processing**
  - **Utilize 100% Of TMD Software And Develop Additional 25% NMD Unique Software**
- **Reconfigure THAAD Dem / Val Radar Into GBR-P Beginning In FY 97 To Reduce Cost And Risk**
- **Advanced Discrimination Algorithms Inserted Into GBR Software Block Upgrades**
- **Advanced T/R Modules Being Tested**
- **Deployable NMD-GBR Will Produce Hardware From Existing TMD Lines**





## **BM/C<sup>3</sup> / SEI PROGRAM CONTRACTING STRATEGY**

---

- **Single Contractor To Minimize Risk And Enhance Product Integration**
- **Competitive Contract Awarded 24 AUG 95 To TRW Team**
- **Integrated Product Development Of NMD Three Plus Three Program**
  - **BMDO Leads System Engineering Effort**
  - **BMDO Leads Specification Of All BM/C<sup>3</sup> Products To Be Developed**
    - **USA Leads Development Of Site-level Products**
    - **USAF Leads Development Of CINC-level Products**





# UEWR CONTRACTING STRATEGY

---

- **Planned FY 97 Contract Award For UEWR Prototype Development**
  - **USAF / ESC Contract Supporting BMDO NMD Program**
  - **Incremental Prototype Demonstrations And Experiment**
  - **Level Of Effort - Approximately \$12 Million**





## **BM/C<sup>3</sup> / SEI PROGRAM CONTRACTING STRATEGY**

---

- **Single Contractor To Minimize Risk And Enhance Product Integration**
- **Competitive Contract Awarded 24 AUG 95 To TRW Team**
- **Integrated Product Development Of NMD Three Plus Three Program**
  - **BMDO Leads System Engineering Effort**
  - **BMDO Leads Specification Of All BM/C<sup>3</sup> Products To Be Developed**
    - **USA Leads Development Of Site-level Products**
    - **USAF Leads Development Of CINC-level Products**





# **SMTS CONTRACTING STRATEGY**

---

- **SBIRS Decision Transferred Resources For SMTS To USAF But Retained Flight Demonstration Approach**
- **Existing Competitive Contract Vehicles Supported Early Milestones And Deployment Decisions**
  - **SMTS Contracts Awarded To Rockwell And TRW / Hughes Teams In FY 93 To Develop Dem / Val Flight Demonstration Systems**
  - **Funding Reductions Forced Contract Restructuring**
- **Down Selected To TRW / Hughes (May 1995) To Develop And Fly Two Flight Demonstration Satellites, Rockwell Maintained As Non-flyer For Technology Demonstrations And Competition For EMD**
- **Baseline Program Schedule Launches First Objective Satellites In FY 06**





## **SUMMARY OF CONTRACTING OPPORTUNITIES**

---

- **Competition For Booster And/Or Integrating Prime In FY 97**
  - Approach: TBD
  - Approximate Contract Value: TBD
- **SMTS EMD**
  - Contract Award: Down Select - Late FY 01
  - Approximate Contract Value: TBD
- **Planned FY 97 Contract Award For UEWR Prototype Development**
  - USAF / ESC Contract Supporting BMDO NMD Program
  - Incremental Prototype Demonstrations And Experiment
  - Approximate Contract Value: TBD
- **NMD Targets Development**
  - NMD Requirement: 1-2 Targets Per Year
  - Approximate Contract Value: TBD

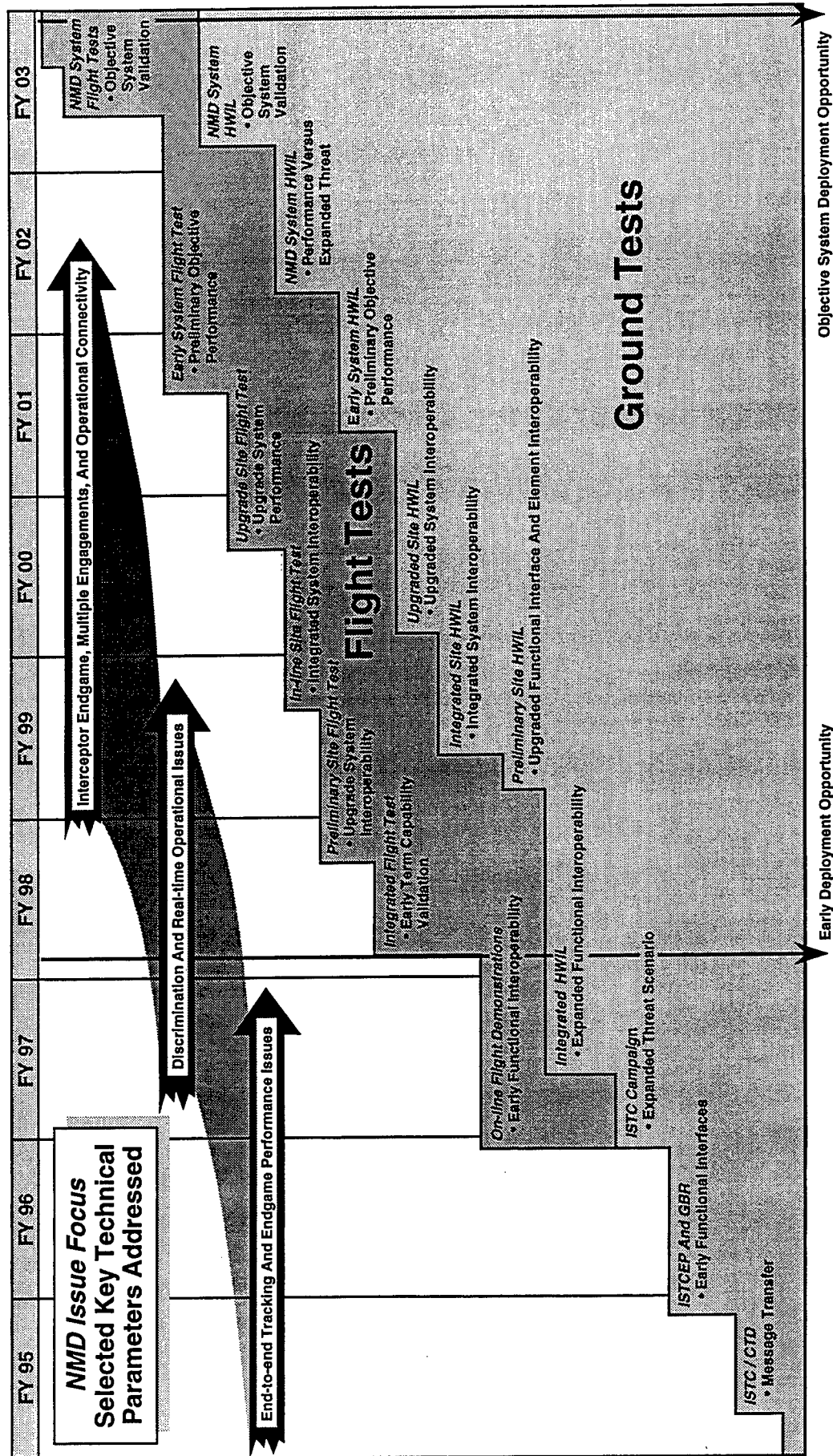


# BACKUP





# NMD INTEGRATED TEST PROGRESSION









# Theater Missile Defense Program Overview



**April 1996**

**Brig Gen Curtis Emery II, USAF  
Deputy For Acquisition / Theater Missile Defense  
Ballistic Missile Defense Organization**





# THEATER MISSILE DEFENSE MISSION NEED

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“Capabilities For Active Defense Are Required To Protect Against TMs By Destroying Missiles In Flight. Boost, Post Boost, Midcourse, Long-range, Or High Altitude Interception Of In-flight TMs Is Necessary To Prevent Saturation Of A Forward Combat Commander’s TM Point Defenses, To Negate Potential Warhead Effects, And To Ensure Minimal Leakage In Defense Of Critical Assets. Therefore, Active Defenses Must Consist Of Defense In Depth. A Defense In Depth Provides Multiple Opportunities To Negate The TMs With Differing Technology, Increases The Probability Of A Kill, And Prohibits The Enemy From Being Able To Counter The Defense System With A Single Technique.”

Admiral David Jeremiah, USN  
Chairman, JROC  
Vice Chairman, JCS  
18 NOV 91

True Then... True Now !





# CONGRESSIONAL POLICY DIRECTION

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## *Sec. 233 Ballistic Missile Defense Policy*

- It Is The Policy Of The United States

(1) To Deploy Affordable And Operationally Effective Theater Missile Defenses To Protect Forward-deployed And Expeditionary Elements Of The Armed Forces Of The United States And To Complement *The Missile Defense Capabilities* Of Forces Of Coalition Partners And Of Allies Of The United States . . .

**Missile Defense Act Of 1995**



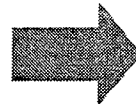


# THEATER MISSILE DEFENSE THREAT AND MISSION

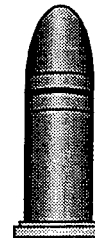
## Threat

What Is The Problem ?

- Range
- Warheads
- Missile Technology
- Quantity
- Penetration Aids



**Threat Spectrum  
And Characteristics  
Are Wide And Varied**

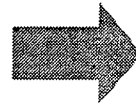


**A Single Bullet  
Cannot Do It  
All !!**

## Mission

What To Protect ?

- Troops
- Populations
- Assets
- Multiple Theaters
- Prepositioned Support



**Mission Space  
(Who, What, Where To  
Protect) Is Enormous  
And Complex**





# TMD ACQUISITION APPROACH

---

- Build On Existing Capability
- Proceed With Low-to-Moderate Risk
- *Introduce TMD Upgrades To Theaters Through CINC Assessments Program*
- Encourage International Participation





# NEAR TERM CAPABILITIES (FY 95-97)

Program Area	Underway
<ul style="list-style-type: none"> <li>• PAC-2 (Quick Reaction Program) / Guidance Enhancement Missile (GEM)</li> </ul>	<ul style="list-style-type: none"> <li>• Improved TBM Detection, Tracking, And Intercept Capability</li> <li>• Improved Accuracy Against TBMs</li> <li>• Increasing Battlespace</li> </ul>
<ul style="list-style-type: none"> <li>• TALON SHIELD / JTAGS / Radiant Ivory</li> </ul>	<ul style="list-style-type: none"> <li>• Provides TBM Warning To Various CINCs</li> </ul>
<ul style="list-style-type: none"> <li>• TPS-59 (Radar) / HAWK Upgrade</li> </ul>	<ul style="list-style-type: none"> <li>• Enhancing TBM Surveillance And Tracking For USMC HAWK Intercept</li> <li>• Cueing Other Theater Sensors</li> </ul>
<ul style="list-style-type: none"> <li>• CINCs' TMD Assessments</li> </ul>	<ul style="list-style-type: none"> <li>• CPXs On TMD Tactics, Warning And Cueing, Plans And Procedures</li> </ul>
<ul style="list-style-type: none"> <li>• BM/C<sup>3</sup> (Early Warning Data Dissemination)</li> </ul>	<ul style="list-style-type: none"> <li>• Expanding User Availability Of Early Warning Information</li> </ul>
<ul style="list-style-type: none"> <li>• Gaming At Joint NTF</li> </ul>	<ul style="list-style-type: none"> <li>• Focused "Warfighters" On TMD Employment And Interoperability Issues</li> </ul>





# **MIDTERM CAPABILITIES (FY 99-2006)**

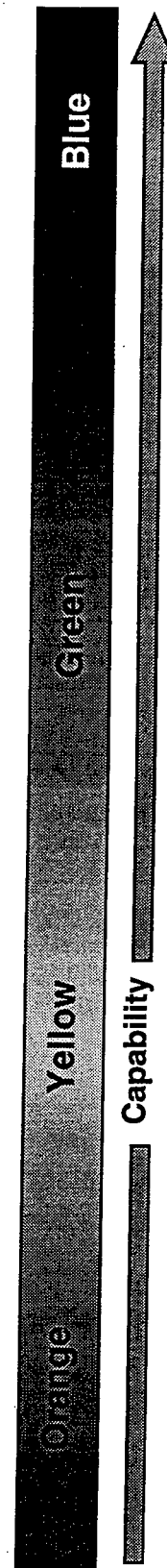
Program Area	What We Are Going To Do
<ul style="list-style-type: none"> <li>• THAAD System</li> </ul>	<ul style="list-style-type: none"> <li>• First Wide Area Protection Against TBMs</li> <li>• Provide Multiple Shot Opportunities</li> <li>• Enhance Protection Effectiveness</li> <li>• User Operational Evaluation</li> <li>• Contingency Capability (FY 99-06)</li> <li>• FUE 2006</li> </ul>
<ul style="list-style-type: none"> <li>• PATRIOT PAC-3</li> </ul>	<ul style="list-style-type: none"> <li>• Improve Lethality Against TBMs</li> <li>• Increase Protected Area</li> <li>• Provide Remote Launch Capability</li> <li>• Improve Discrimination</li> <li>• Improve Low Altitude Performance</li> <li>• FUE 1999</li> </ul>
<ul style="list-style-type: none"> <li>• Navy Area Defense System</li> </ul>	<ul style="list-style-type: none"> <li>• Improve Detection And Intercept Effectiveness</li> <li>• Improve Warhead Against Hard Targets</li> <li>• User Operational Evaluation</li> <li>• FUE 2002</li> </ul>





# THEATER SCHEDULE

	FY 94	FY 95	FY 96	FY 97	FY 98	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	FY 06
THAAD System				Engineering Development △		Final UOES Missile Delivery ◇				MS III Full Rate Production △	◇	First Unit Equipped	
PATRIOT PAC-3	Engineering Development ▲				Full Rate Production First Unit Equipped ◇	Full Rate Production △							
Navy Area			Engineering Development △				UOES ◇		First Unit Equipped ◇				
							Full Rate Production △						







# ADVANCED CONCEPTS (FY 2006+)

Program Area	What We Are Going To Do
<ul style="list-style-type: none"> <li>• Navy Theater Wide System</li> </ul>	<ul style="list-style-type: none"> <li>• Significantly Increase Range And Lethality Of Missile</li> <li>• Provide Greater Defense In Depth</li> <li>• Increase Shot Opportunities = Higher Probability Of Kill</li> </ul>
<ul style="list-style-type: none"> <li>• MEADS</li> </ul>	<ul style="list-style-type: none"> <li>• Provide Maneuver Forces TBM Protection</li> <li>• Counter Cruise Missile Threat</li> <li>• Increase Tactical Mobility</li> <li>• Decrease Strategic Lift Requirement</li> </ul>
<ul style="list-style-type: none"> <li>• Boost Phase Intercept</li> </ul>	<ul style="list-style-type: none"> <li>• Kill TBM In Boost Phase (Counter Submunitions)</li> <li>• Defeat Deployed Countermeasures</li> <li>• Assure Shortfall Of Debris And Unexpended Munitions</li> </ul>





# **BMD PROGRAM REVIEW: FINDINGS ON TMD**

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## ***Department's BMD Program Review Priorities For TMD***

- **First Priority Is To Defend Against Theater Ballistic Missiles And Cruise Missiles**
  - **Short- To Medium-range Missiles In Theater - TMD Lower Tier**
  - **Area Defense And Longer-range Theater Missiles - TMD Upper Tier**
- **TMD Program Changes Respond To Threats, Program Status And Fiscal Reality**
  - **Fully Support Lower Tier Systems**
  - **Upper Tier - Phased Deployment With Benefits From NMD Technology**





# COMPARISON OF DATES

Program	FY 96 PB	Fact Of Life	BMD PR	Inf Adj	Congress
PAC-3 - FUE	FY 98	FY 99	FY 99	FY 99	FY 98
NAD - UOES - IOC / FUE	FY 98 FY 00	FY 99 FY 01	FY 99 FY 01	FY 00 FY 02	FY 97 FY 99
THAAD - UOES - FUE	FY 98 FY 02	FY 98 FY 02	FY 98 FY 04	FY 98 FY 06	FY 98 FY 00
NTW - UOES - IOC	Program Decision FY 98	Program Decision FY 98	KV Decision FY 98	KV Decision FY 98	FY 99 FY 01





## SUMMARY

---

- Program Reflects Strong Support Of Congress And Current Administration
- BMDO Is Focused On TMD - Developing And Acquiring Systems
- TMD Program Strategy
  - Builds On Existing Systems To Provide Near Term Capability To Meeting Existing Threats
  - Adds New Systems And Enhancements To Provide Robust Protection





## **TMD PROGRAM OVERVIEW PRESENTATIONS TO FOLLOW**

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- Col John Upton, USMC, Director, Systems Applications
  - Near-term TMD Program
- Col Richard Ritter, USAF, Director, System Integration/BM/C<sup>3</sup>
  - BM/C<sup>3</sup> Program
- COL Andrew Fallon, USA, Director, Test & Evaluation
  - Facilities, Siting, Testing & Evaluation Programs
- COL James Lingvai, USA, Director, Modeling and Simulation Programs
- CAPT John Langknecht, USN, Director, Joint Force
  - Joint Force User Interface



### TMD Mission Need

This is Admiral Jeremiah's statement, as the chairman of the JROC, regarding the need for defense in depth to provide multiple shot opportunities for active defenses. It was true then and it's true now.



### **Congressional Policy Direction**

The FY1996 Authorization Report contained a new Missile Defense Act with an important change that I want to highlight. It is now the policy of the United States that theater missile defenses are not only to protect forward-deployed forces but to also complement the missile defense capabilities of our friends and allies. This means we must continue to focus our BM/C3 program to operate jointly among the Services and interoperate with our allies and friends.



### TMD Threat and Mission

The threat we face today covers a wide spectrum. The proliferation of missiles of various ranges and warhead types, as well as progressively higher levels of sophistication, continues. Trying to decide what the mission space should be—the who, what and where to protect—is enormous and complex. The unavoidable conclusion is that if we intend to have a meaningful defense against ballistic missiles, we cannot do it with a single interceptor system. Our TMD rationale today is this—we know a single bullet cannot do it all, but we cannot pursue all the needed bullets at once.



### **TMD Acquisition Approach**

Our approach for executing the TMD acquisition process is first and foremost to build on our existing capability in active defense systems in the near term. The threat is here and now. We plan on incremental enhancements to current systems to enable them to handle a wide range of scenarios and deployments. Second, we are proceeding with low to moderate risk programs that will provide an early User Operational Evaluation System (UOES) capability. Third, we plan to introduce TMD upgrades to theaters through the CINCs Assessment Program. Again, we encourage international participation in the development of the TMD programs to better complement the missile defense capabilities of our allies and friends.



BMDO is focusing on Near Term capabilities (FY95-97) to include enhancing the PATRIOT by improving its capability with the PAC-2 Guidance Enhancement Missile (GEM). Last year, we began producing PAC-2 GEM system for the Army as the principal improvement to our existing TMD capability until the PAC-3 system begins deployment in FY1999. The PAC-2 GEM improvements increase the PATRIOT's defended area and improves its lethality over its capabilities during Operation Desert Storm. The GEM's improved seeker performance allows the interceptor to more precisely locate the target missile. Meanwhile, a faster reacting warhead fuze contributes to a more optimal dispersal of warhead fragments on the target.

Just as important, we have deployed significant improvements to our ability to provide early warning information of ballistic missile launches to U.S. forces overseas. Last year, the Air Force activated the Attack and Launch Early Reporting to Theater (ALERT) squadron with the BMDO-developed TALON SHIELD at Falcon Air Force Base, Colorado Springs, Colorado. The Joint Tactical Ground System (JTAGS), also developed by BMDO, is a complementary tactical mobile DSP ground station for use in theater. The Army has deployed two prototypical units, one in Germany and one in South Korea, to support the warfighter. Five of these units will be produced and fielded in FY1996-97.

BMDO supports a Marine Corps TMD Initiative that provides a basic TMD capability for the Marine Corps to sustain an interim point defense of vital assets in the amphibious operating area. Our tests have shown that a modified TPS-59 radar combined with the HAWK missile system is effective against short range ballistic missiles. Delivery of the upgraded systems to operational Marine Corps units will continue during this fiscal year. This program delivers a real military capability against the short range missile threat for a modest investment.

The Commanders-in-Chiefs (CINCs) TMD Assessments Program consists of operational exercises, wargames, and Warfare Analysis Lab Exercises (WALEX). The CINC TMD Assessment program enhances two-way communication between BMDO as the developer and the warfighting CINCs who are the users of TMD systems. These exercises allow the CINCs to assess their TMD capabilities and shortfalls so they may refine and articulate their TMD requirements, and improve their current and future TMD operational capabilities. The program facilitates the development and refinement of TMD doctrine and concepts of operations as part of the CINC's and Joint Staff's overall theater operational plans. The WALEX program allows senior military leadership insights into TMD operational planning and employment. There are 20 scheduled events in this program for FY1996.

We are planning several improvements in BM/C<sup>3</sup> (DSP data dissemination) such as improved launch and impact point accuracy and reducing the timelines for processing and disseminating that information. Over-the-horizon sensor cueing of a fire control radar extends the radar's detection range and increases the protected area. These enhancements are particularly important in the presence of jamming and weather clutter. My objective is to make sure that we fully exploit the intrinsic capabilities of our existing air and missile defense systems by providing improved defenses in the interim period prior to Core TMD program maturation and deployment.

These improvements not only recognize today's threat, but represent an attitude of cost savings because we are building on existing systems.



### Midterm Capabilities (FY 97-2004)

I will now discuss the TMD Core Programs that will provide the midterm capabilities: THAAD System; PATRIOT PAC-3; and Navy Area TBMD.

The **THAAD System** mission is to defeat tactical ballistic missile threats directed against military forces, critical assets and **wide area protection** for assets such as population centers and industrial resources. The THAAD system consists of the TMD-GBR, surveillance and tracking sensor, interceptors, launchers, and BMC3. The THAAD system fulfills the user requirement for **multiple shot opportunities** to intercept theater ballistic missile threats. Multiple shot opportunities are necessary to neutralize threats carrying weapons of mass destruction at higher altitudes and longer ranges to achieve the required level of defense. THAAD provides Upper Layer of defense for **enhanced protection effectiveness** with PATRIOT. The THAAD Program is currently in Demonstration/Validation and undergoing a series of flight tests designed to resolve technical issues and demonstrate the system's capabilities. The program will reach Milestone II in early FY97. The initial deployment in FY98 will be what the Department calls a "UOES plus" system, essentially an enhanced version of the UOES system, in lieu of the previously planned full-capability objective system. This improved UOES capability will meet the most critical THAAD requirements for a **contingency capability from FY99-04**. It will concentrate on militarizing the UOES design and upgrading certain components, such as the infrared seeker, radar upgrades and BMC3 improvements. The resulting THAAD program delays first unit equipped (FUE) by over two years to **FY2004**.

The **PATRIOT (PAC-3) system** will represent a significant upgrade to an existing air and missile defense system to specifically handle stressing theater-class ballistic missile threats. The PAC-3 system, using hit-to-kill interceptors, will be highly lethal against ballistic missiles including those with weapons of mass destruction. Improvements to the system will result in **increased firepower and lethality; increased battlespace and range; enhanced battlefield awareness; and improved discrimination performance**. These critical enhancements will be achieved by improvements to the missile, as well as the radar and communications systems. Operational improvements, such as **remote launch operations**, will also increase the battlespace and range of the PAC-3 system. These enhancements will mark a substantial improvement over our PATRIOT TMD capabilities during Operation Desert Storm. **PAC-3 FUE date is planned for FY1999.**

The Navy and BMDO have been cooperatively working to develop an enhancement to the **AEGIS/Standard Missile** air defense system that would provide a tactical ballistic missile defense capability from the sea that is comparable to that provided by the PAC-3. A Naval TMD capability could be in place within a regional conflict area to provide TMD protection for land-based assets before hostilities erupt or before land-based defenses could be transported to the theater. The SM-2 Blk IVA program focuses on modifications to enable **tactical ballistic missile detection, tracking and engagement** with a modified SM-2 Blk IVA. Our plan is to field a **UOES capability** in FY1999 and an **FUE** in FY2002.



### **Theater Schedule**

This chart displays the development schedules for the three TMD Core programs, adjusted for the Department's BMD Program Review and inflation.



### The Advanced Concepts (FY2002 and beyond)

Navy Theater Wide TBMD Program will bring a new, complementary capability to our other core programs by providing ascent phase coverage where the mobility of AEGIS ships allows such coverage. The system will provide an upper tier sea-based capability that significantly increases the range and lethality of Navy TBMD with greater defense in depth and increased shot opportunities. It will require modifying the AEGIS Weapon System to support the employment of the Standard Missile with a kinetic kill intercept vehicle. The program is structured to conduct concept definition studies to determine what is the best configuration with which to proceed.

MEADS (Medium Extended Air Defense System) will be a highly mobile system and designed to be deployed with our forward and maneuvering forces. In this regard, MEADS is designed to respond to an important operational requirement by providing protection for the combat maneuver force against shorter-range theater-class ballistic missiles, advanced cruise missiles, and other air-breathing threats as well. The U.S., Germany, France and Italy will proceed jointly to develop the MEADS system as described in the Memorandum of Agreement signed <sup>when</sup> ~~on March 1, 1996~~.

The boost phase intercept (BPI) program would provide a high payoff defense capability by destroying enemy missiles early in their flight trajectory while they are still over enemy territory. This type of intercept allows for the defense of very large areas and significantly reduces lethality issues. BPI systems furthermore destroy TBMs before booster burnout, before they can release tens to hundreds of canisters of chemical or biological agents, ~~(clustered submunitions)~~. Congress cut BMDO's appropriations for aircraft launched kinetic BPI systems to zero in FY 1996, but appropriated some funding for a cooperative UAV-based BPI concept with Israel.

clustered submunitions or

Rec  
edits



### **BMD Program Review: Findings On TMD**

Several months ago, the Secretary of Defense decided that the Department's whole set of missile defense programs needed a more intensive review and to look for a restructuring of the program portfolio to produce a source of funds for other modernization priorities. The review reaffirmed the fundamental priorities in our missile defense program. The first priority is to defend against theater ballistic missiles and cruise missiles. Within the TMD mission area, the review broke some new ground on defining the underlying sub-priorities. The first sub-priority is to field systems to defend against the existing short-to-medium-range missiles--the lower tier TMD systems. The next sub-priority is to proceed at a prudent pace to add wide area defenses and defenses against the longer-range theater missiles as that threat emerges--the upper-tier TMD systems.

The TMD program changes respond to threats, the program status, and fiscal reality. The Department fully supports the lower tier systems--PAC-3 and Navy Area Defense. The upper tier programs will be a phased deployment approach with benefits derived from NMD technology.



### **Comparison of Dates**

This chart provides a comparison of the program milestone dates for the PAC-3, Navy Area Defense, THAAD, and Navy Theater Wide Defense. The columns show the changes from the FY96 President's Budget, Fact of Life program changes, the BMD Program Review findings, inflation adjustments to those new dates, and Congress' dates in the FY96 National Defense Authorization Act.



### Summary

In summary, I believe we have a solid TMD program in BMDO. The program reflects the strong support of Congress and the current administration. The overall program is focused on TMD active defense with multiservice participation in developing and acquiring systems. The central thrust of the TMD strategy is to build on existing systems to provide near and midterm capability to meet existing threats. This strategy includes upgrading HAWK and the TPS-59 radar, PATRIOT, the addition of the THAAD system as an upper or mid course tier, and the provision of a sea-based TBMD capability with AEGIS/SM-2 Blk IVA. A principal TMD goal is to deploy a THAAD UOES as soon as possible. We are determined to add new systems and enhancements to provide robust protection.



100

# **Joint Force Directorate “The Bridge To The Warfighter”**



**10 APR 96**

**CAPT John Langknecht, USN  
Director, Joint Force  
Acquisition / Theater Missile Defense Deputate  
Ballistic Missile Defense Organization**





# JOINT FORCE DIRECTORATE

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## *Objectives*

- **Make BMDO's TMD Programs *Relevant To The Warfighter***
- **Facilitate TMD Warfighting Requirements Development  
And Refinement - Understanding The Customers Needs**





## HOW ?

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- Direct Involvement With Our Customers - The Theater Commanders
- Warfighters At BMDO Talking With Warfighters In The Theaters Through
  - TMD Seminars, Warfare Analysis Exercises, And Planning Exercises
  - War Games
  - Field And Command Post Exercises

**CINC's Assessments**





## **FY 95 ACTIVITY**

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- Expanded Involvement In CINC Assessments In FY 95
  - 7 Exercises
- Expanded International Participation
  - 4 Of 7 Exercises
- Provided First TMD Integrated Data Fusion And Situational Awareness Capability For The Joint Force Commander
  - U.S. European Command (EUCOM) - "TMD Coordination Cell"





## **FY 96 ACTIVITY**

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- **Level Of TMD Activity Continues To Increase -  
14 Total Exercises In FY 96**
  - U.S. European Command (EUCOM) - 5 Exercises
  - U.S. Central Command (CENTCOM) - 3 Exercises
  - U.S. Pacific Command (PACOM) - 3 Exercises
  - U.S. Forces Korea (USFK) - 1 Exercise
  - U.S. Atlantic Command (USACOM) - 2 Exercises
- **11 Of The 14 Have International Participation**
  - Including: U.K., Japan, Canada, Netherlands, Germany, France, Spain, Korea, And Thailand
- **Providing TMD Coordination Cell Upgrade To  
EUCOM And Four Other CINCs**





## FY 96 CINC ASSESSMENTS PROGRAMMED EVENTS

---

- |  |  |
|--|--|
| • TMD WALEX, USACOM, 20 NOV 95           | • Cobra Gold, USPACOM, 15-24 MAY 96      |
| • JTF 96-1, USACOM, 29 NOV-18 DEC 95     | • Matador, USEUCOM, 17-25 MAY 96         |
| • TMD WALEX, USCENCOM, 8-12 JAN 96       | • Roving Sands, USCENCOM, 10-16 JUN 96   |
| • 6th Fleet TMDEX, USEUCOM, 15-18 JAN 96 | • RIMPAC, USPACOM, 10-16 JUN 96          |
| • Keen Edge, USPACOM, 21 JAN-4 FEB 96    | • TMD PLANEX, USFK, 15-16 JUL 96         |
| • Internal Look, USCENCOM, 20-27 MAR 96  | • Trailblazer, USEUCOM, 2-12 AUG 96      |
| • TMD PLANEX, USPACOM, 15-19 APR 96      | • Ulchi Focus Lens, USFK, Dates (TBD)    |
| • Optic Windmill, USEUCOM, 15-19 APR 96  | • Foal Eagle, USFK, Dates (TBD)          |
| • NATO WALEX, 16 APR 96                  | • Dynamic Mix, USEUCOM, 19 SEP-12 OCT 96 |
| • CJTFEX 96-2, USACOM, 28 APR-17 MAY 96  |  |
| • WARGAME 96A, USPACOM, 29 APR-3 MAY 96  |  |
- 

**Total Events = 20**





## **CY 97 CONTRACT OPPORTUNITY**

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- **BMDO Has Need For Contracted Support For The CINCs TMD Assessments Program That Will Be Recompeted This Year**
- **Small Business Set Aside**
- **Announced In The Commerce Business Daily In March 1996**
- **Request For Proposal Will Be Released In April 1996**
- **Released Draft Statement Of Work On The Electronic Bulletin Board**
- **All Instructions Can Be Found In CBD**







**SECRET** unclassified  
classified material removed

# Near Term Programs (U)



April 1996

Col John Upton, USMC  
Director, Systems Applications  
Acquisition / Theater Missile Defense Deputate  
Ballistic Missile Defense Organization

Derived From: Multiple Sources  
Declassify On: Exempt (X3)

**SECRET** unclassified

mj-59960A / 032896



## INTRODUCTION

Good afternoon, Ladies and Gentlemen. I am Colonel John Upton and I head the System Applications Directorate. Within the Directorate are a number of programs which we intend to complete within the "near-term", or 2-4 years. I have selected four of these to serve as a cross-section of examples of the types of efforts we have sponsored. Their R&D values range from approximately \$50M to \$120M. All were begun several years ago and are progressing, so if you have attended this briefing previously, my presentation will serve primarily to update you. The AQ Deputate, approximately 2 years ago, established an internal process, called the Current System Improvement Program, through which we solicited candidates for sponsorship. Unfortunately, the budget has not allowed for a new effort.

I'll also present some information on the multi-national air defense program known as MEADS or Medium Extended Air Defense System. It certainly is not a near term program, but there is likely to be some interest. I'll focus on programmatics and Dr Martin, who heads Strategic Relations within BMDO, will discuss the international aspects.

## USMC TMD INITIATIVE

### INTRODUCTION

The Marine Corps TMD Initiative was established between BMDO and the Marine Corps Systems Command in 1992 to provide a point defense capability against short range ballistic missiles. That class of weapon is viewed as the primary missile threat against our expeditionary forces. The Commission on Roles and Missions recommended that the Corps retain its organic air defense capability until the arrival of the next generation system--MEADS. At that point, the Army will assume responsibility for providing land based extended air defense for Marine Forces. In the interim, we will continue to maintain the HAWK system in some form.

### CONCEPT OF OPERATIONS

This chart depicts the equipment and communications protocols involved. The TPS-59 air surveillance radar serves as a surrogate acquisition radar for the HAWK weapon system since the acquisition radars organic to HAWK have neither the range nor the look-up capability to detect ballistic missile targets. The 59 will detect and track TBM's determining launch point, impact point, and state vector information. Lockheed Martin and Sensis Corporation, both in Syracuse, NY are doing the radar upgrade.

The TBM information is passed to HAWK over a point to point data link via the Air Defense Communications Platform. It is from here that the targeting information is made available to other theater sensors by a TADIL-J transmission. A geographical filter



is also done whereby a determination is made whether or not HAWK can engage. If a shot is available, cueing information is sent to the Battery Command Post. A company in Austin, Texas called Advanced Programming Concepts is doing this work.

The Battery Command Post uses the cueing data to steer the high power illuminator onto the target. Raytheon has completed this effort and production kits are presently being fabricated.

Not unexpectedly, the missile itself requires modification for faster fuzing and larger grain warhead pellets. Some 300 of these improved lethality missiles are in stock now with another 700 or so planned to be retrofitted.

#### TPS-59 and USMC HAWK

This slide summarizes much of what I've described, but I would be remiss not to mention the international interest. Numerous nations own TPS-59's or FPS-117's, which is of the TPS-59 family, in conjunction with HAWK.

We have received many requests for information from nations in the Western Pacific, Middle East, and Europe. In the past year, Marines have made presentations to senior officials in Kuwait and South Korea.

#### Developmental Flight Test Results

This past November and December, the three components went to developmental testing at White Sands Missile Range and did quite well. The results are shown on this slide. [Read the chart]

#### SUMMARY

To summarize the program then, ... [Read the chart]

### **TALON SHIELD AND ALERT**

#### Talon Shield Overview

Under the mission area of launch detection and warning, USSPACECOM has a three legged system called TES for Tactical Event System. The three legs of TES are sponsored respectively by the Air Force, the Navy, and jointly by the Army and Navy. The Air Force piece called ALERT grew out of and continues to be supported by TALON SHIELD. TALON SHIELD allows improvements to be developed, tested, and verified without having to impact the 24 hour a day operational system. AEROJET is the prime on this effort.

As you can see here, ... [Just read the chart]

#### ALERT System Performance



The situation between Taiwan and China has occupied everyone's interest over the past few weeks, and the Chinese missile shots were, of course, monitored by many of our systems. Here are the results from ALERT. [Read the chart]

### AWACS EAGLE

#### Cueing Accuracy

The notion of an acquisition sensor handing off initial target information via a state vector has acquired great credibility in the past few years. In fact, this concept of "cueing" is now integral to our architecture, especially with regard to the upper tier systems.

This chart depicts cueing accuracy improvements achieved since Desert Storm by TES and those we expect to achieve by a system now under development called EAGLE.

#### AWACS EAGLE

Eagle consists of a passive infrared search and track sensor and an eye-safe laser ranger to be installed aboard AWACS aircraft. Boeing is the prime contractor for this work.

The program's objective... [Read the chart]

#### Current Status

[Read the chart]

### MEADS

#### MEADS Mission Description

MEADS is a multi-national development program which we are in the process of establishing in conjunction with France, Germany, and Italy. It is intended to replace HAWK and eventually PATRIOT.

The weapon is to provide... [Read the chart]

#### U.S. Concept of Operations

[Read the chart]

#### General Program Strategy

Two international teams are to compete during the Project Definition and Validation Phase. The US members of the respective teams are Hughes-Raytheon and Lockheed Martin. They have been each teamed with equally capable, distinct segments of a European conglomerate composed of Aerospatiale, Thompson, DASA, Siemens, and Alenia. A downselect to one team will occur at the



end of the Project Definition and Validation Phase and that team will continue on into Design and Development.

Program Schedule

[Read the chart]

CONCLUSION

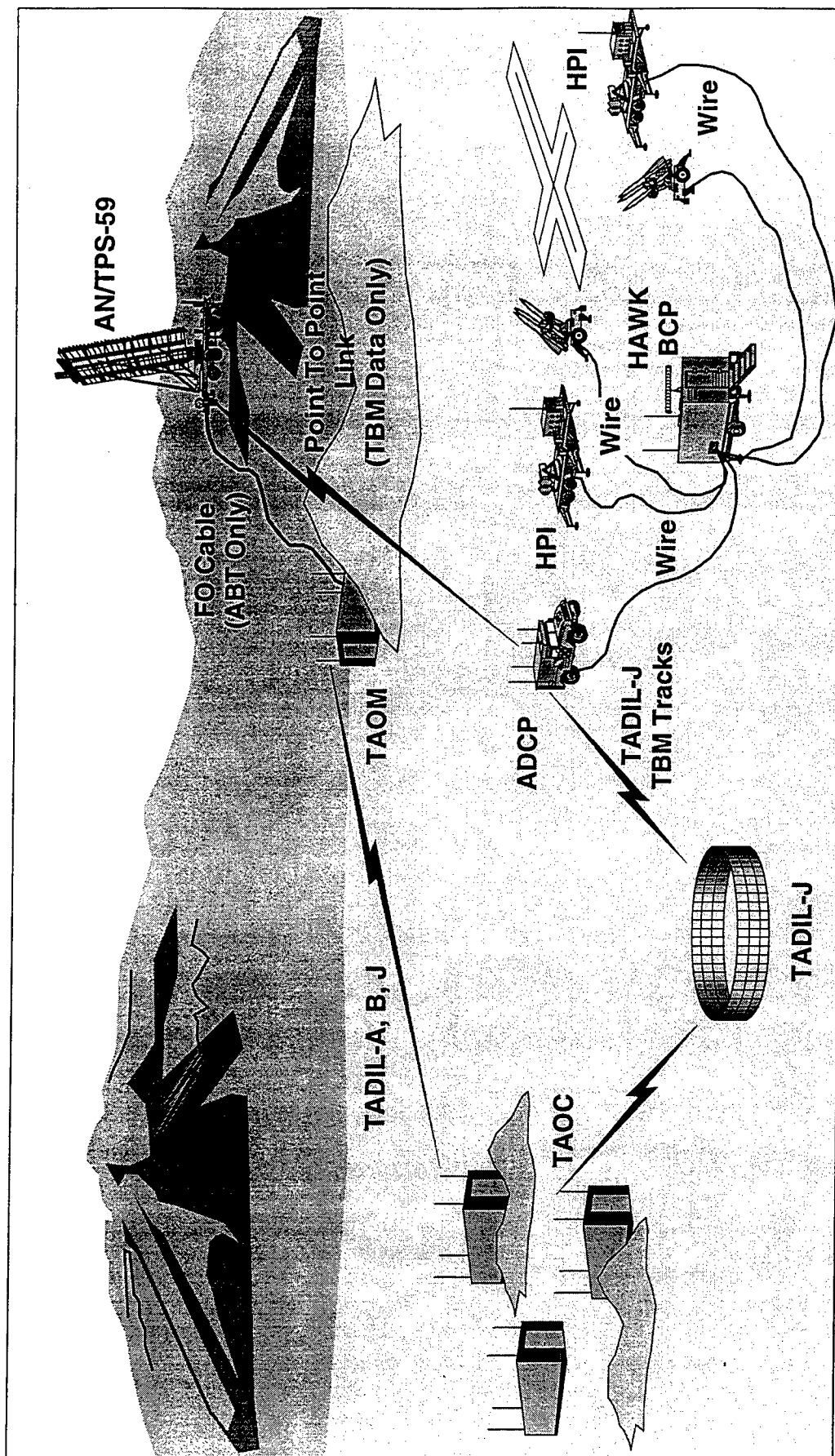
This concludes my briefing. I hope what has been presented is of value to you, either from a business standpoint or as citizens interested in the nation's development of theater missile defense. In either case, I look forward to meeting with you later in the program.





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# CONCEPT OF OPERATIONS



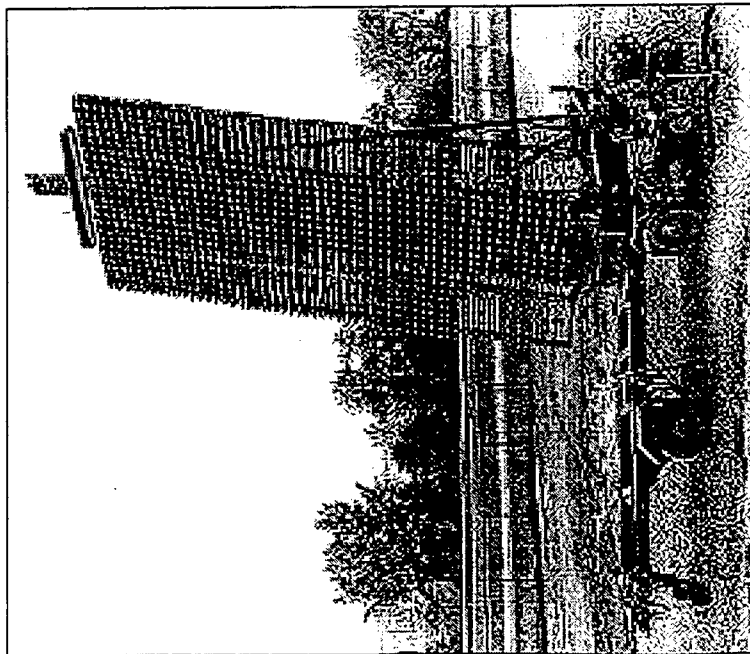
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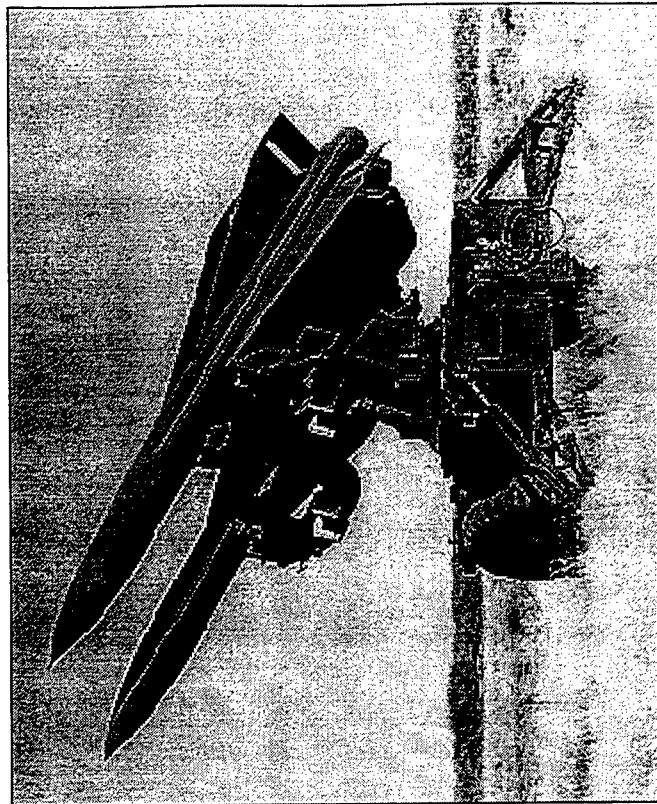


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## TPS-59 AND USMC HAWK



- Upgrade TPS-59 To Provide Enhanced TBM Surveillance And Tracking Capability
- Air Defense Command Post To Act As A Node For Tactical Nets
  - Make TPS-59 Data Available On A JTIDS Net
- Modify Battery Command Post To Accept TPS-59 Data, For Acquisition By HAWK Radar
- Upgrade HAWK Missile Fuze And Warhead For TBM Engagements



- Upgrade Of HAWK Launcher To Interface With Digital Missiles
- Upgrade Of HAWK Launcher To Increase Mobility

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## SUMMARY

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- Developmental Testing Successfully Completed
- Operational Testing Scheduled For May / June 1996
- Milestone III Decisions Slated For 4th Quarter FY 96
- Marine Corps Ballistic Missile Defense Initial Capability Scheduled For Early FY 97
- Developmental Equipment Could Be Used For Contingency Operations If Required

**Marine Corps Tactical Missile Defense Initiative  
Provides Protection For Marine Forces Against  
Short Range Ballistic Missiles**

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## TALON SHIELD OVERVIEW

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- Real-time Data Fusion From Multiple Satellites And Other Sensors
- Improved Sensitivity, Speed, And State Vector Accuracy
- Air Force Fielded System Named ALERT
- First Squadron Activated 1 OCT 94 At Falcon AFB
- Became Operational 15 MAR 95
- Sensor Integration And Software Integration Effort Continues

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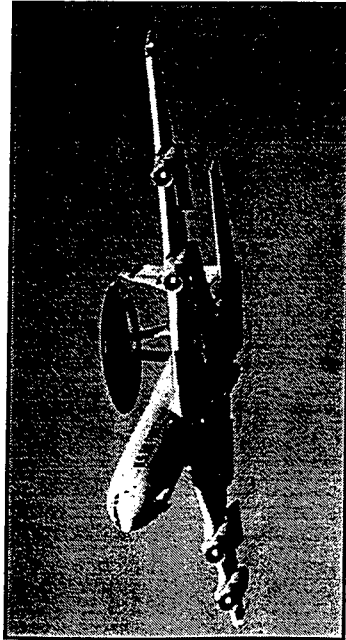


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# AWACS EAGLE (INFRARED SEARCH AND TRACK)

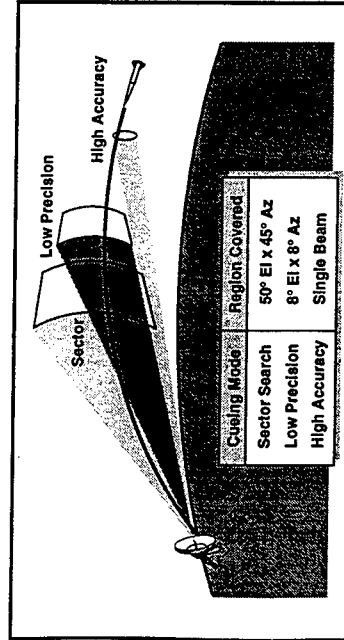
- Objective

- Develop And Demonstrate Prototype Airborne Sensor For Late Boost / Early Post Boost Missile Detection And Tracking
- Transmit Precise Cues To Fire Control Radars



- Approach

- Maximize Capabilities Of Existing Sensors And Weapon Systems
- Utilize Operational Aircraft As Platform (AWACS)
- Up-front Involvement With The User Throughout Development Process



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## CURRENT STATUS

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- Air Combat Command (ACC) Concept Of Operation Signed
- Draft Operational Requirements Document In Final Coordination
- Technical Requirements Document Completed
  - Sensor Performance, Reporting Time
- Streamlined Acquisition Effort Underway
  - ESC / AWD-D (AWACS SPO) Providing Program Management
  - Prototype Sensor Design / Fabrication / Integration Underway Using Commercial Off-the-shelf And Nondevelopment Items (COTS, NDI)
  - Prototype Sensor Integrated Onto AWACS TS-2 Test Aircraft (November 1997)
  - Streamlined EMD 1Q FY 99 With Initial Operational Capability In FY 00
- Three ABM Treaty Compliance Reviews Completed

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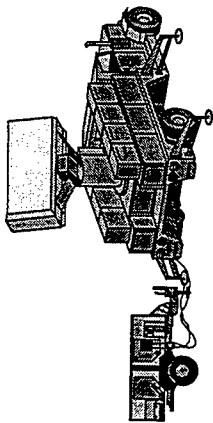




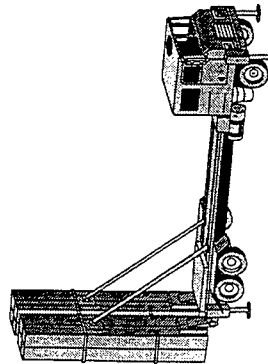
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## MEDIUM EXTENDED AIR DEFENSE SYSTEM (MEADS) MISSION DESCRIPTION

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- Provides 360 Degree Protection Against Short-Medium Range Tactical Ballistic Missiles, Cruise Missiles And Other Air Breathing Threats
- Supports Maneuver And Expeditionary Forces
- Highly Survivable And Operationally Versatile, Distributed / Netted Architecture
- Strategically / Tactically Deployable (C-141 / C-130 / C-160) With Tactical Mobility To Support Maneuvering Forces



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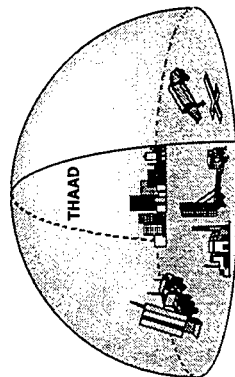




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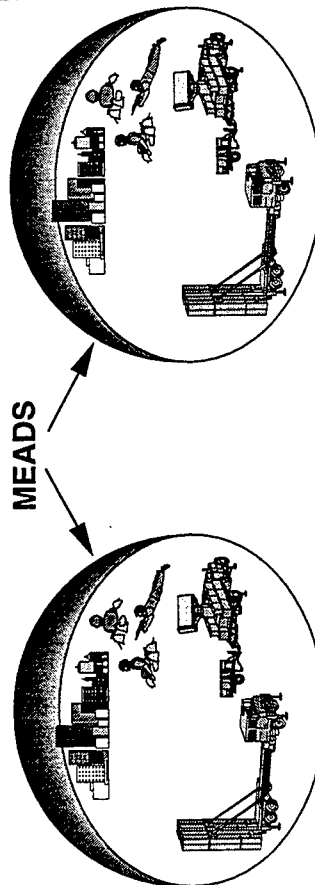
# U.S. CONCEPT OF OPERATIONS

## Early Entry / Lodgement

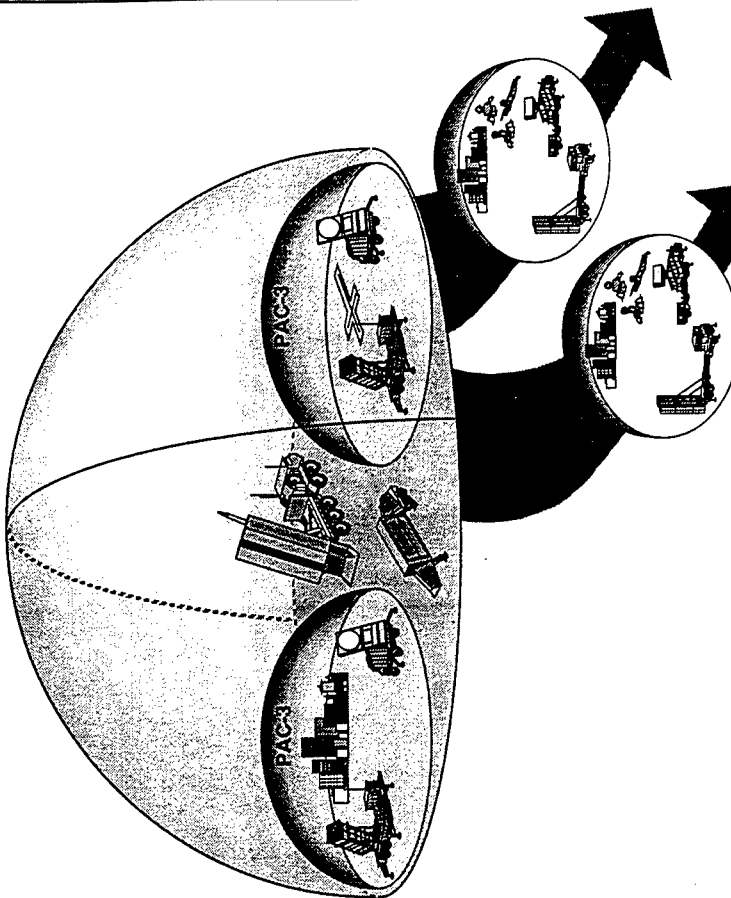


THAAD Or MEADS  
Deploys First Based On Threat And CINC's Desires

- Echelons Above Corps (EAC) / Theater Mission
  - Cities
  - PODs
  - Initial Force Concentrations



## Expansion / Decisive Operations



- Forces Build Up In Theater
- PAC-3 Arrives - Replaces MEADS EAC Mission
- MEADS Moves Out With Corps Elements
  - Assembly Areas
  - Sustainment
  - Choke Points
  - Decisive Operations

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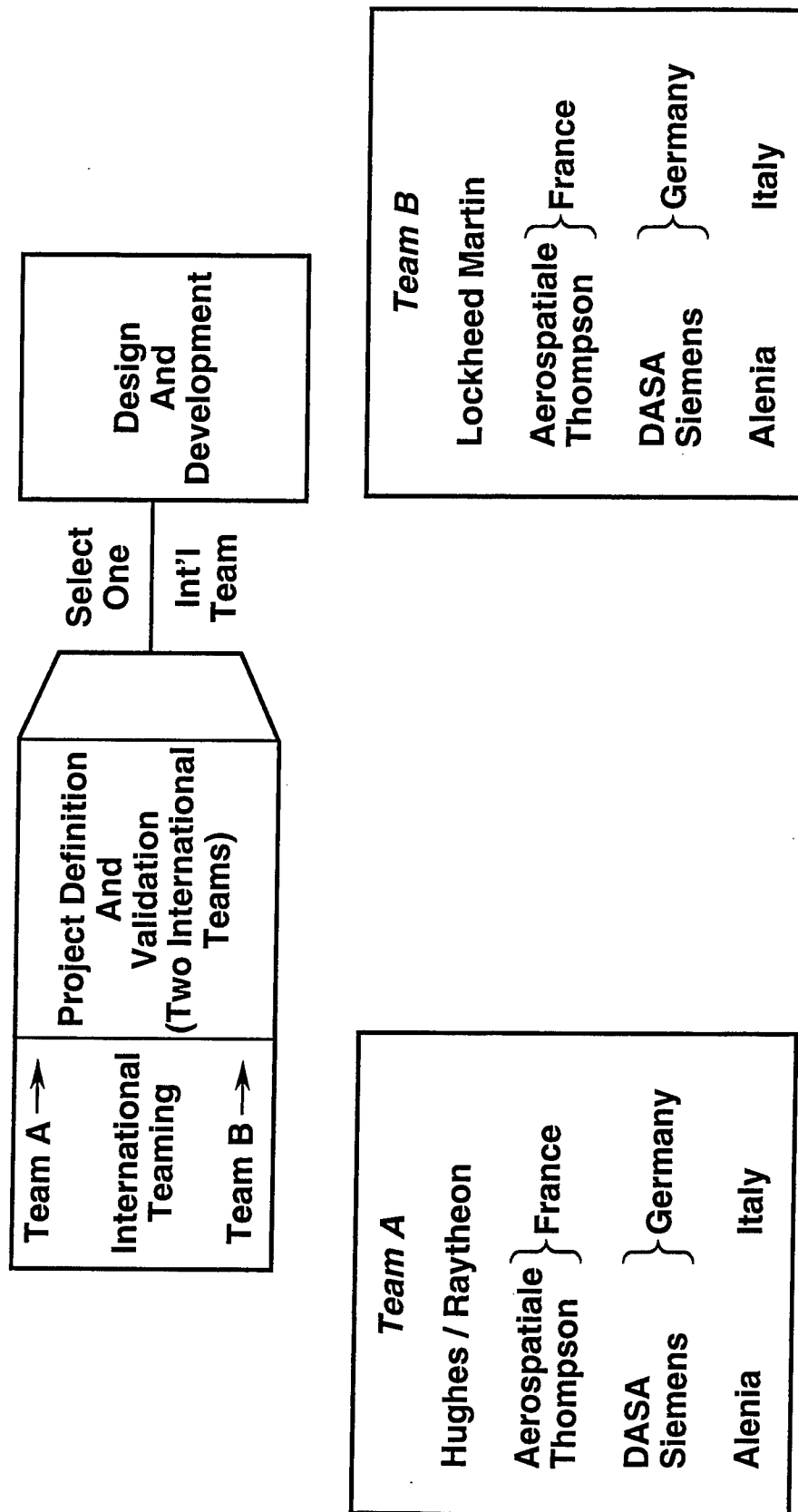
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# MEADS GENERAL PROGRAM STRATEGY



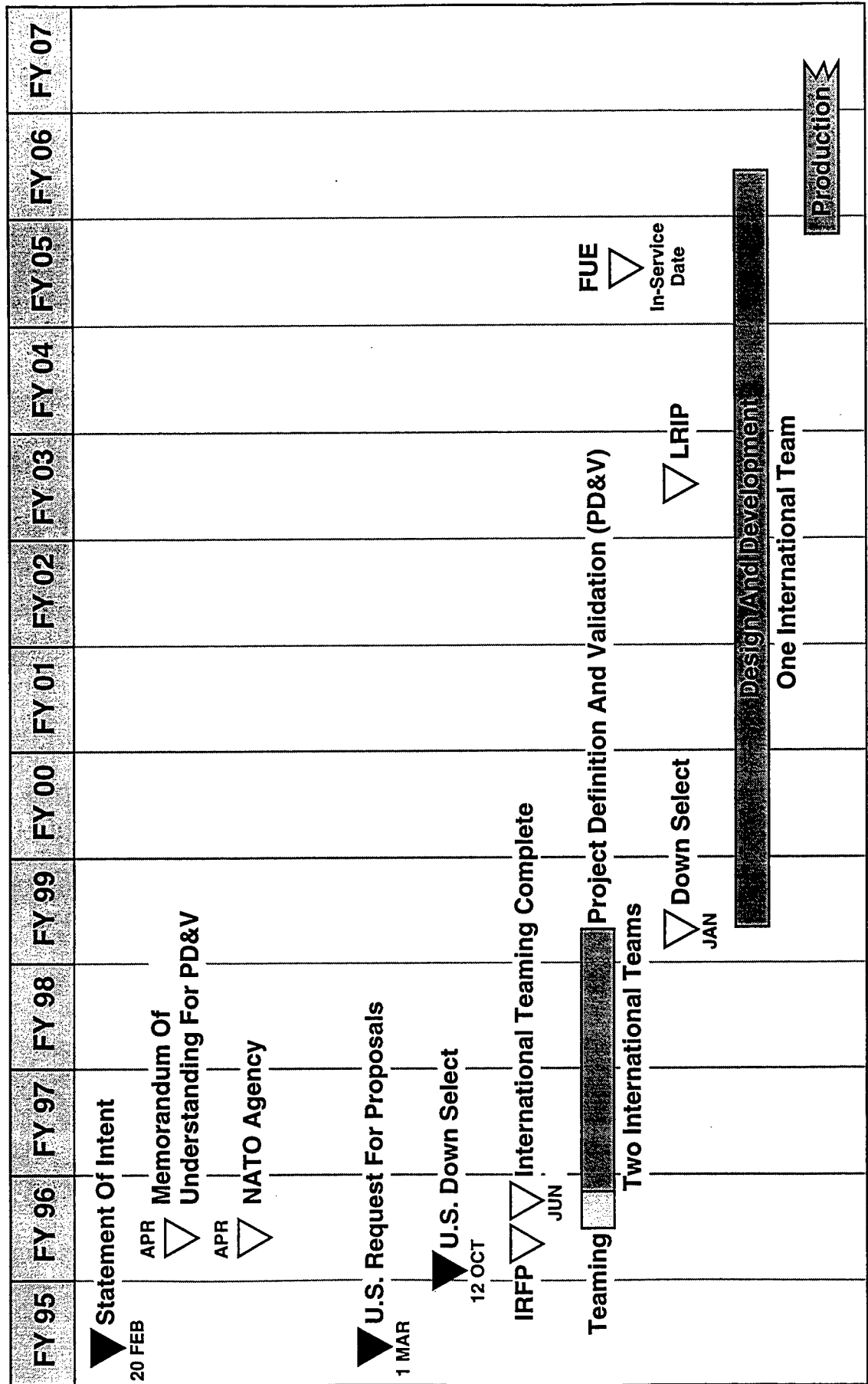
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# MEADS PROGRAM SCHEDULE



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# Theater Missile Defense (TMD) C<sup>3</sup> Program



April 1996

**Col Richard A. Ritter, USAF**  
**Director, System Integration / BM/C<sup>3</sup>**  
**Acquisition / Theater Missile Defense Deputate**  
**Ballistic Missile Defense Organization**





# **TMD C<sup>3</sup> PROGRAM OBJECTIVE**

---

- **Building Upon The Existing And Planned Theater Air Defense C<sup>3</sup> Structure**
  - **Integrate The C<sup>3</sup> Components Of Multiple, Independently Developed TMD Programs Into A Single, Cohesive, Seamless System**
  - **Provide The CINC A C<sup>3</sup> Capability With The Flexibility For A Wide Range Of TMD Scenarios And Deployments**





# **TMD C<sup>3</sup> CONTRACT OPPORTUNITIES**

---

- **Acquisition Strategy Leverages Existing DoD C<sup>3</sup> Program Initiatives**
  - No "TMD C<sup>3</sup> Stovepipes"
  - No Single TMD C<sup>3</sup> System Contract
- **Contract Opportunities For TMD C<sup>3</sup> Upgrades Exist Across The Services And Multiple Platforms**
- **Key To Success**
  - Strive For Commonality And Interoperability
  - Build To DoD C<sup>3</sup> Design Guidelines
    - Link-16 Data Link Standard
    - Global Command And Control System Operating Environment
    - Joint Technical Architecture





# TMD COMMAND AND CONTROL PLAN

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## *Tasker*

- DepSecDef
- Senior Joint Oversight

## *Purpose*

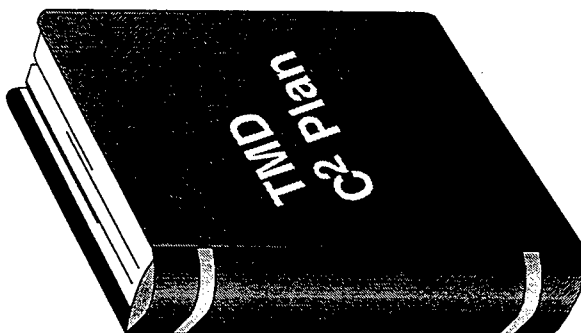
- Supports TMD Capstone COEA
- Foundation For TAD BM/C<sup>4</sup>I EA Architecture Effort

## *Long-range Impacts*

- ASD(C<sup>3</sup>I) Acquisition Decisions
- Guidance For BMDO / Service TAD BM/C<sup>4</sup>I Programs
- Information To CINCs

## *Focus*

- Theater Ballistic Missile Active Defense
- Land Attack Cruise Missile Defense







## **QUESTIONS ADDRESSED IN TMD C<sup>2</sup> PLAN**

---

- **How Can TMD C<sup>3</sup> Support Joint Warfare ?**
- **What Is The TMD C<sup>3</sup> Integrated Architecture ?**
- **How Will The TMD C<sup>3</sup> Capabilities Be Demonstrated ?**
- **What Is The TMD C<sup>3</sup> Implementation Strategy ?**





# HOW CAN TMD C<sup>3</sup> SUPPORT JOINT WARFARE ?

---

## *Overarching Principles*

- Joint Force Commander (JFC) Establishes TMD Command Relationships, Objectives And Guidance
- Centralized Planning At Theater Level With Decentralized Execution At Lower Levels
- Consistent Tactical Picture Is Critical
- Unambiguous Early Warning And Cueing From Space, Air, Ground, And Sea Based Surveillance

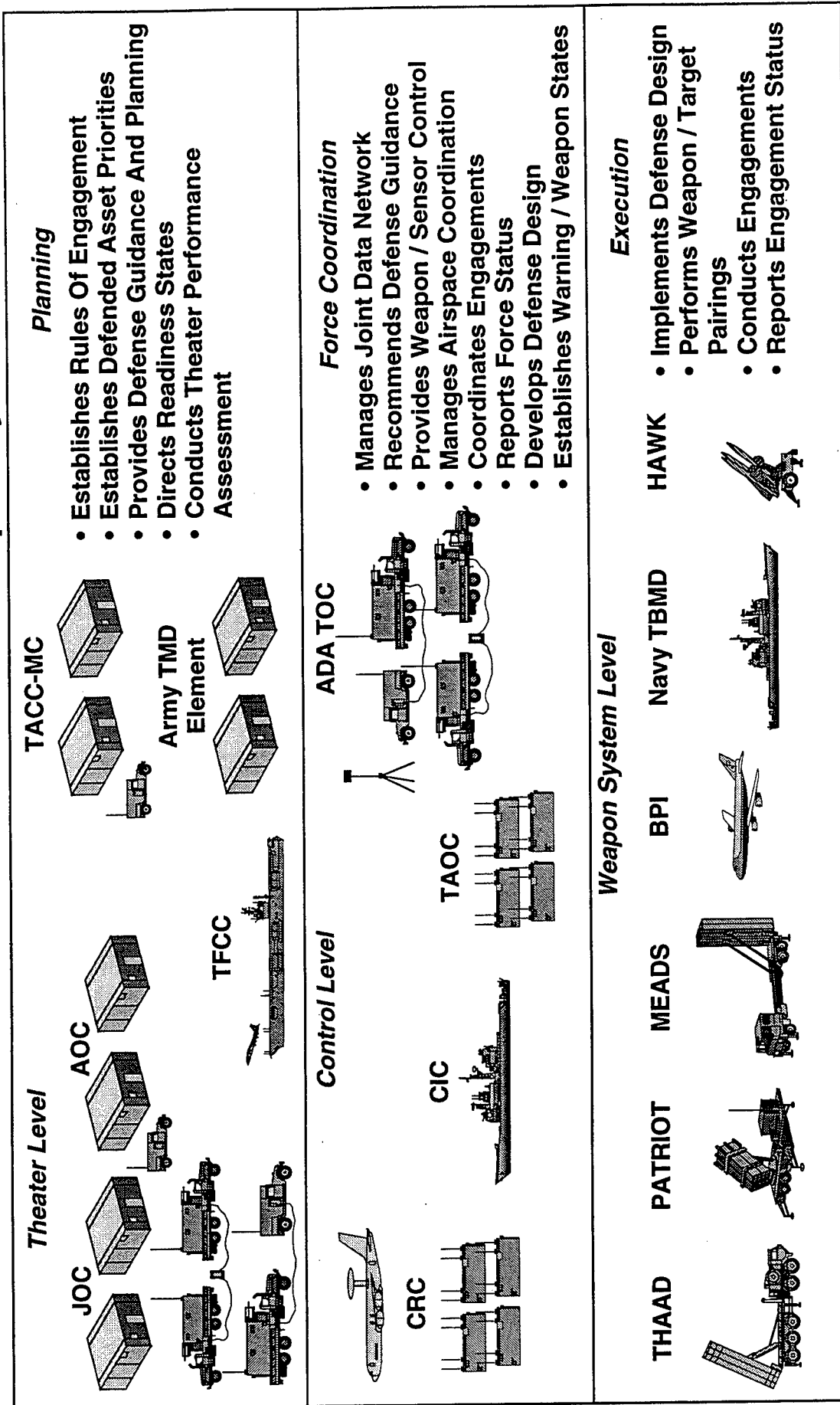
**Provide The CINC A "Plug And Fight" C<sup>3</sup> Capability**





# TBMD C<sup>2</sup> LEVELS AND FUNCTIONS

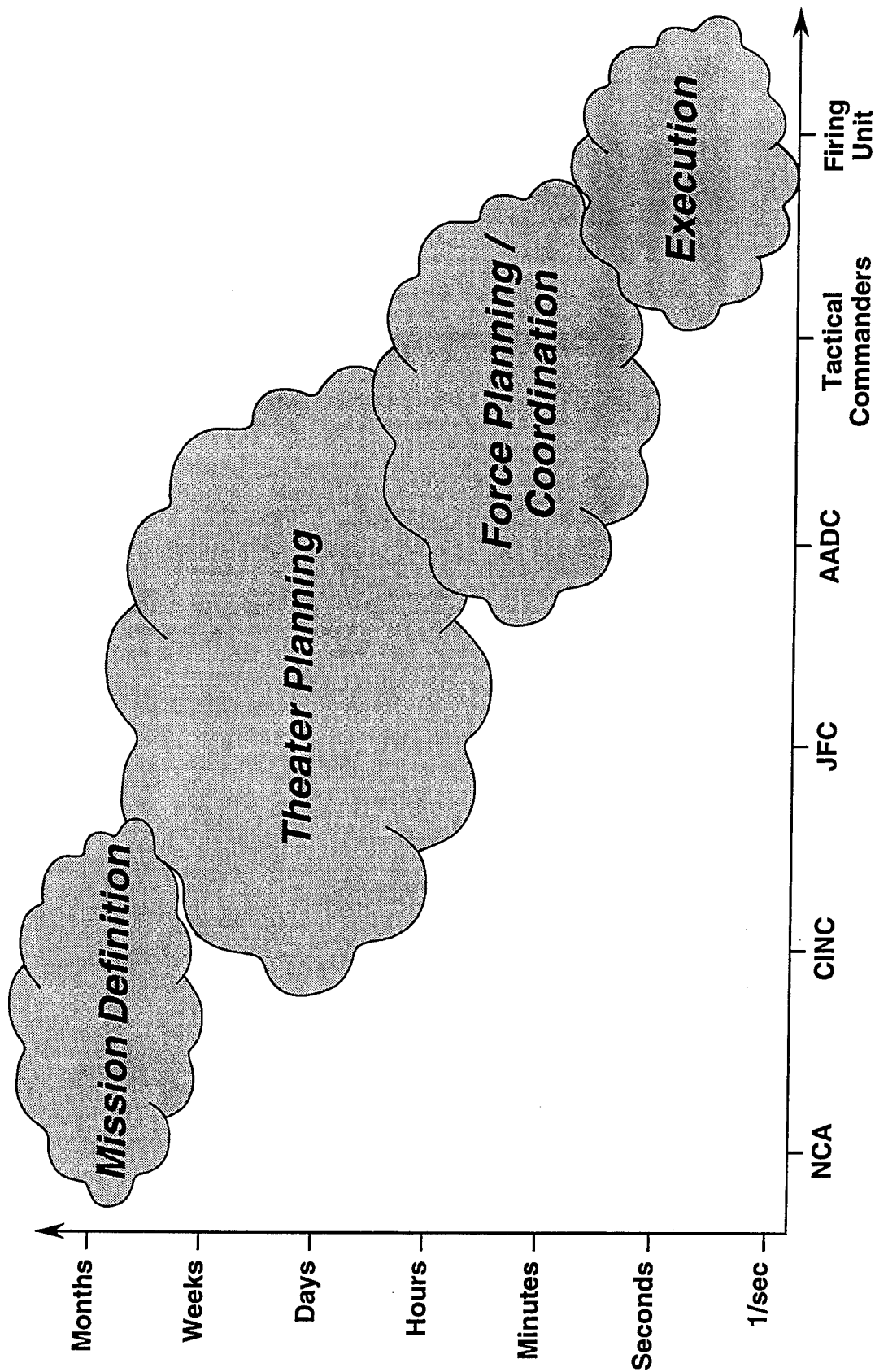
## Standardized Functional Capability







# SPECTRUM OF PLANNING / COORDINATION / EXECUTION

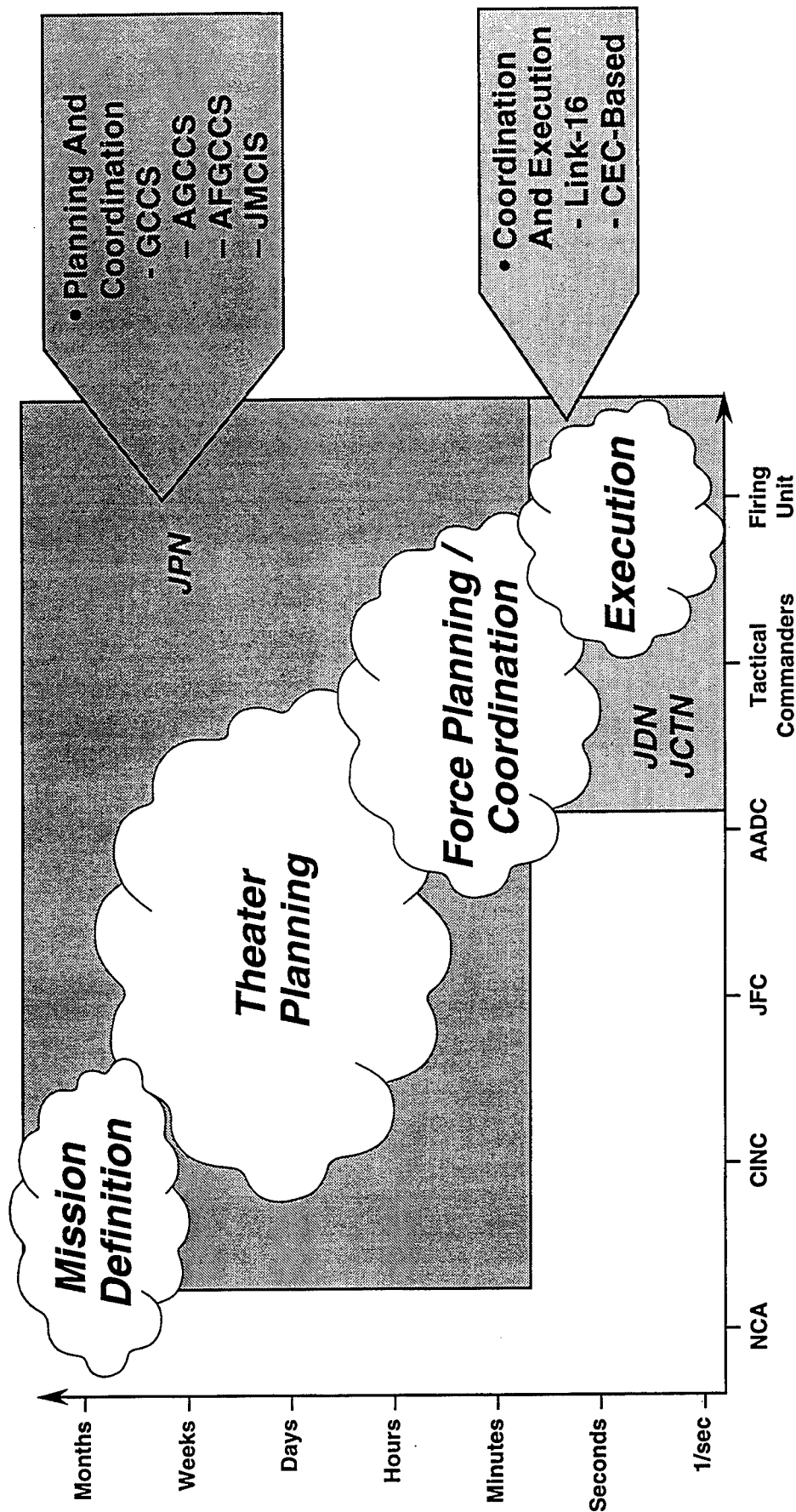






# WHAT IS THE TMD BM/C<sup>3</sup> INTEGRATED ARCHITECTURE ?

## Information Timeliness

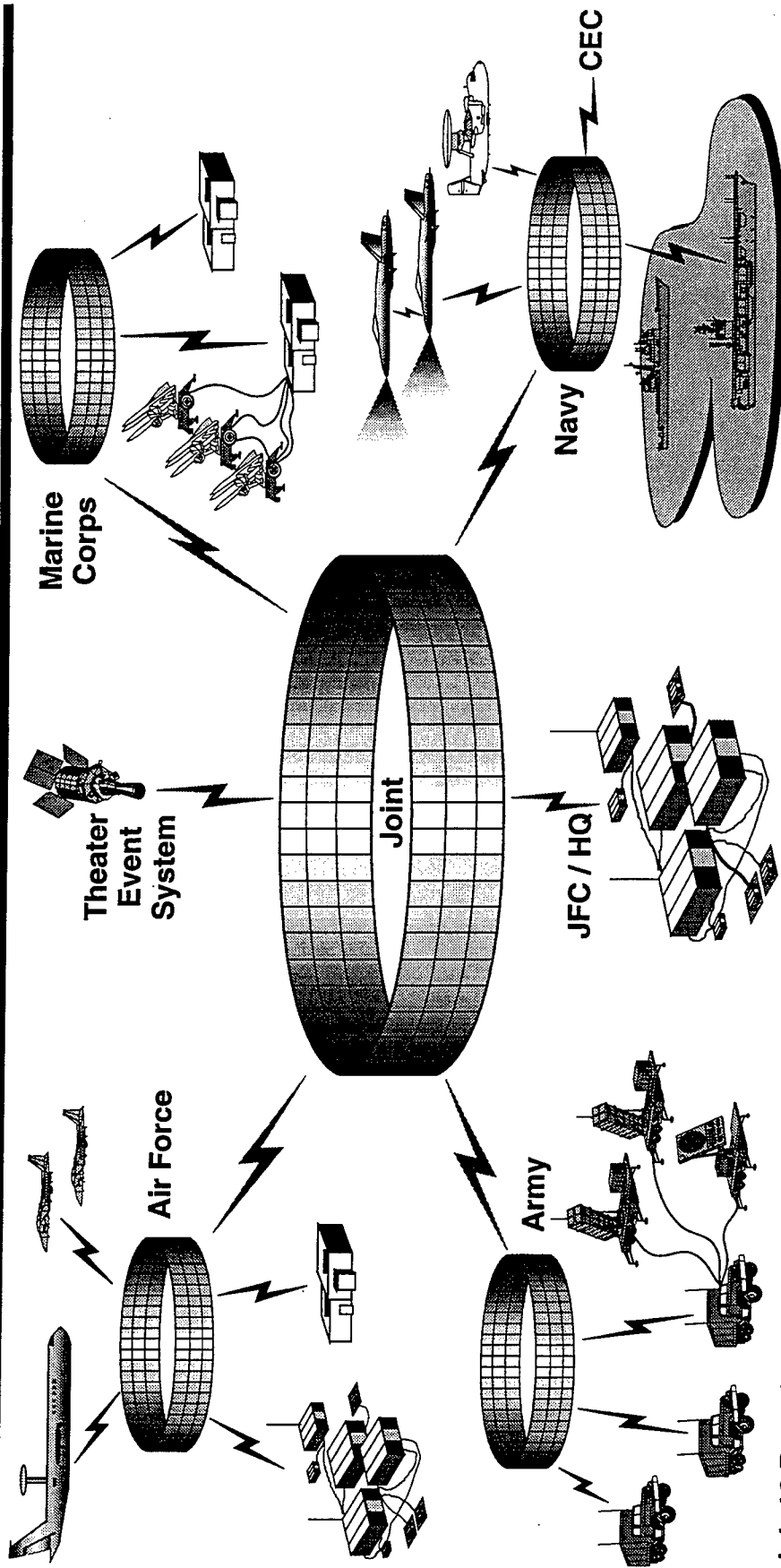


JPN - Joint Planning Net  
JDN - Joint Data Net  
JCTN - Joint Composite Tracking Net





# JOINT DATA NETWORK



- Link-16 Based
- Accommodates New Platforms
- Supports ASD C3I Tactical Data Link Policy

- Theater CINC Flexibility
- Seamless Information Transfer
- Interoperability With Services / Allies

- Early Warning / Cueing
  - Launch Point
  - Impact Point
  - State Vector

- Weapon Coordination
- Near Real-time Information
- Situational Awareness
- Shared Surveillance Information





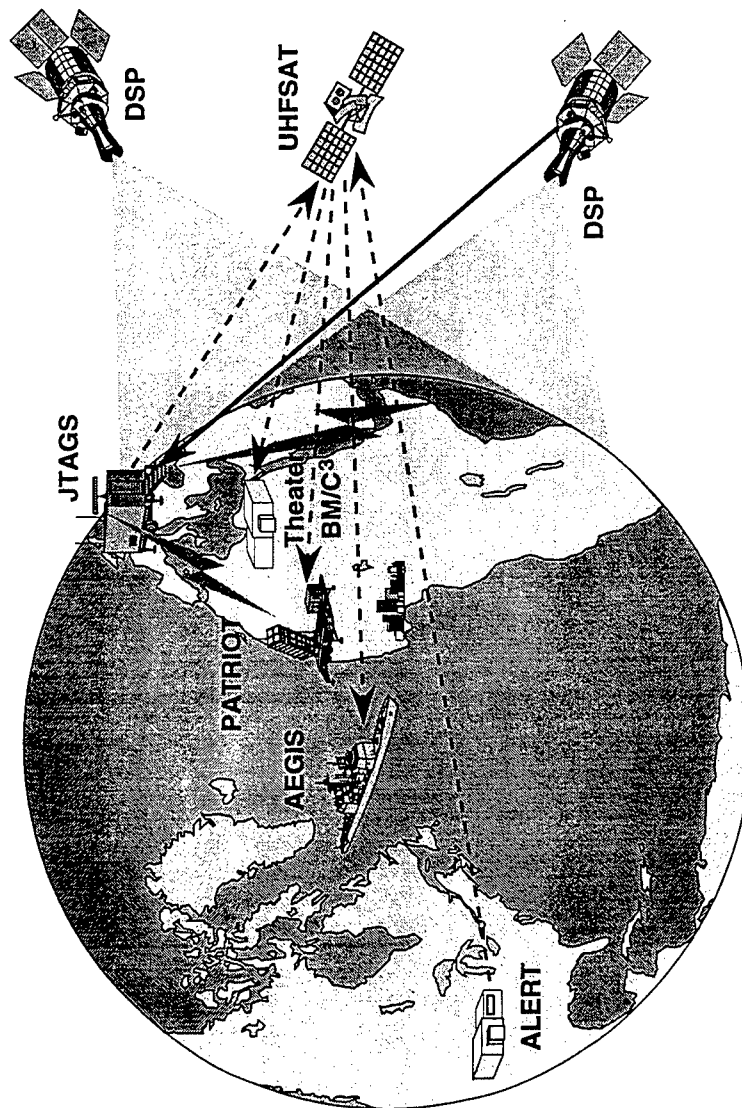
# THEATER EVENT SYSTEM (TES)

## • Description

- ALERT / JTAGS Are Elements Of USSPACECOM TES Warning Architecture
- Provides Launch Point (Attack Ops), Heading (Active Defense) And Impact Area (Passive Defense) Information

## • Architecture Plan

- Correlate TES Reports In Theater
- Integrate TES Inputs Into Joint Data Net
- Accommodate Growth To SBIRS



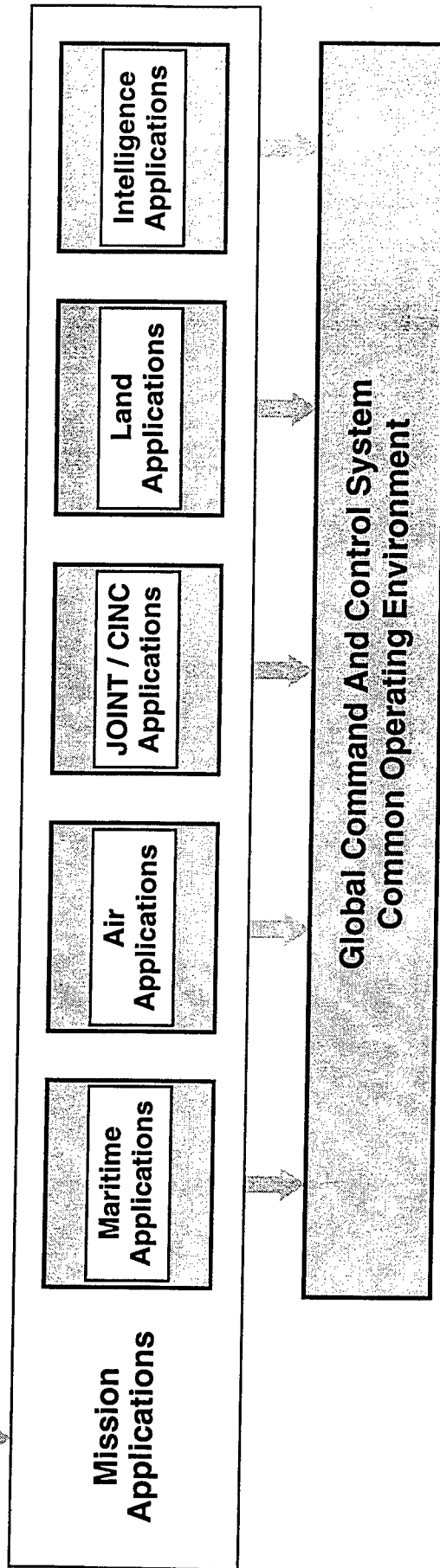




# JOINT PLANNING NETWORK

- JTMD Planner
  - Common Weapon Parameters
  - Preconflict / Wartime Planning
- C2 Applications
  - Red Order Of Battle
  - Defended Asset List
  - Defense Guidance
  - Readiness Status

**TMD Applications**



**Builds On GCCS Software And Communications Infrastructure**





# JOINT COMPOSITE TRACKING NET

---

- Based On Navy's CEC
  - Real-time / Fire Control Quality Data
  - Extremely Fast Transmission Rates
  - Shared Radar Data Among Participants
- Benefits
  - Improved Tracking
  - Enhanced Cueing Of Organic Sensors
  - Support For Engage On Remote Data Capability

**JCTN Will Be Considered In Future  
Weapon Systems**

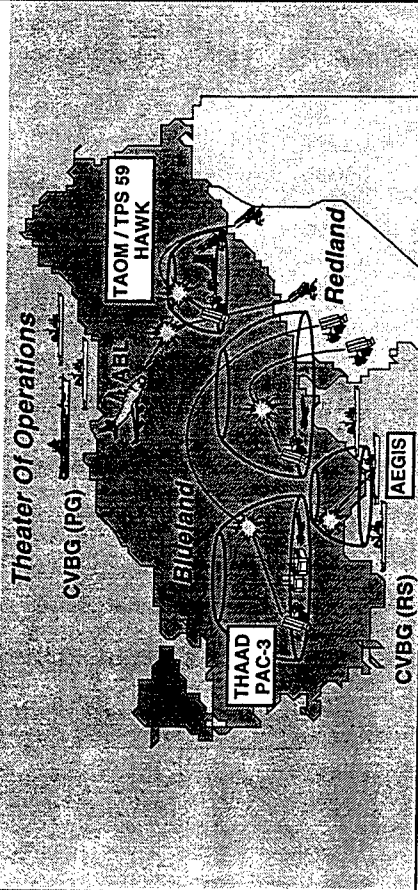




# JNTF TMD BM/C<sup>3</sup> SUPPORT

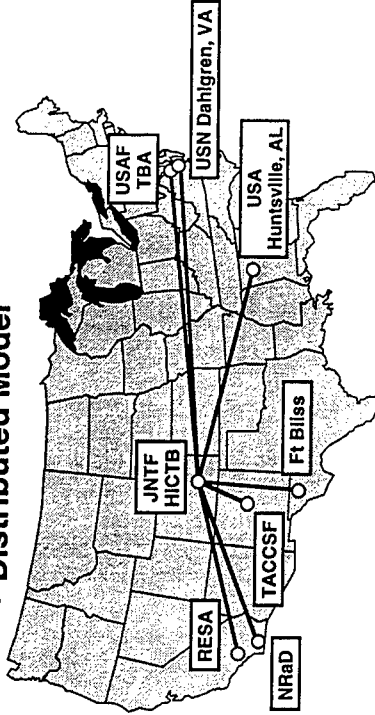
## Exercises / War Game

- CONOPS Development
- Exercise Support



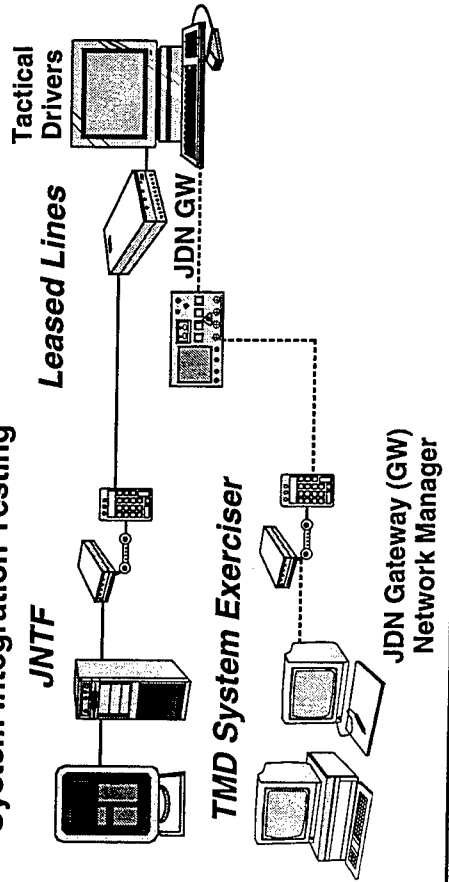
## Modeling / Simulation

- System Threat Support
- Model Development
- Distributed Model



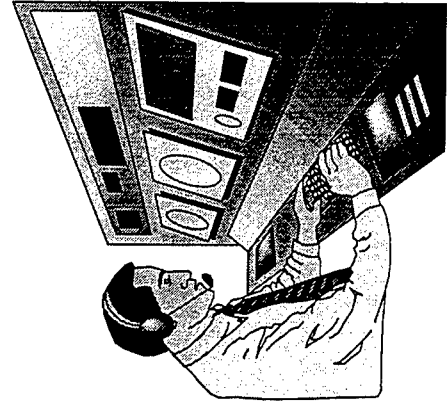
## Test And Evaluation

- HWIL
- System Integration Testing



## Integration

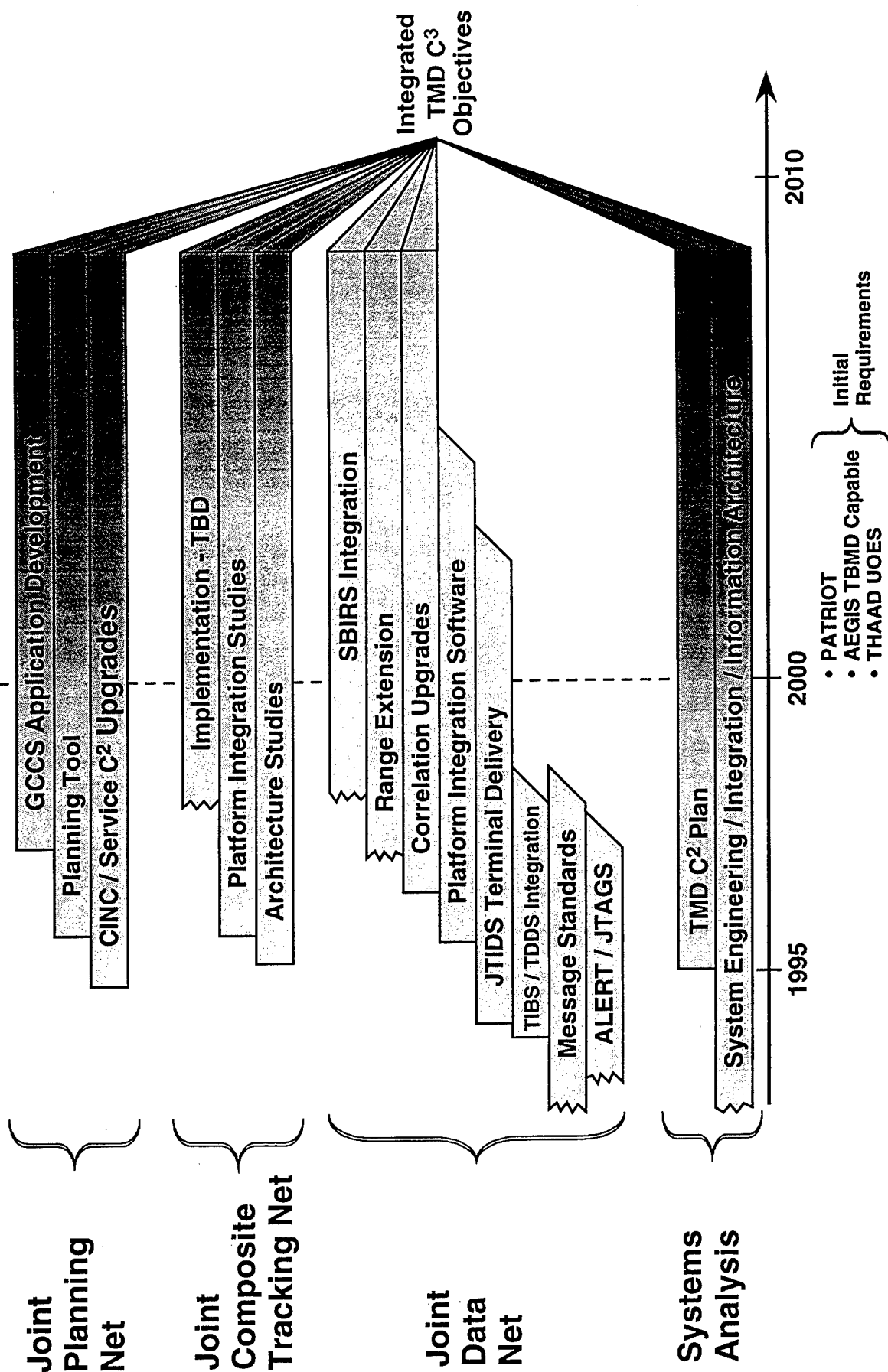
- GCCS Integration
- Advance Decision / Planning Aids







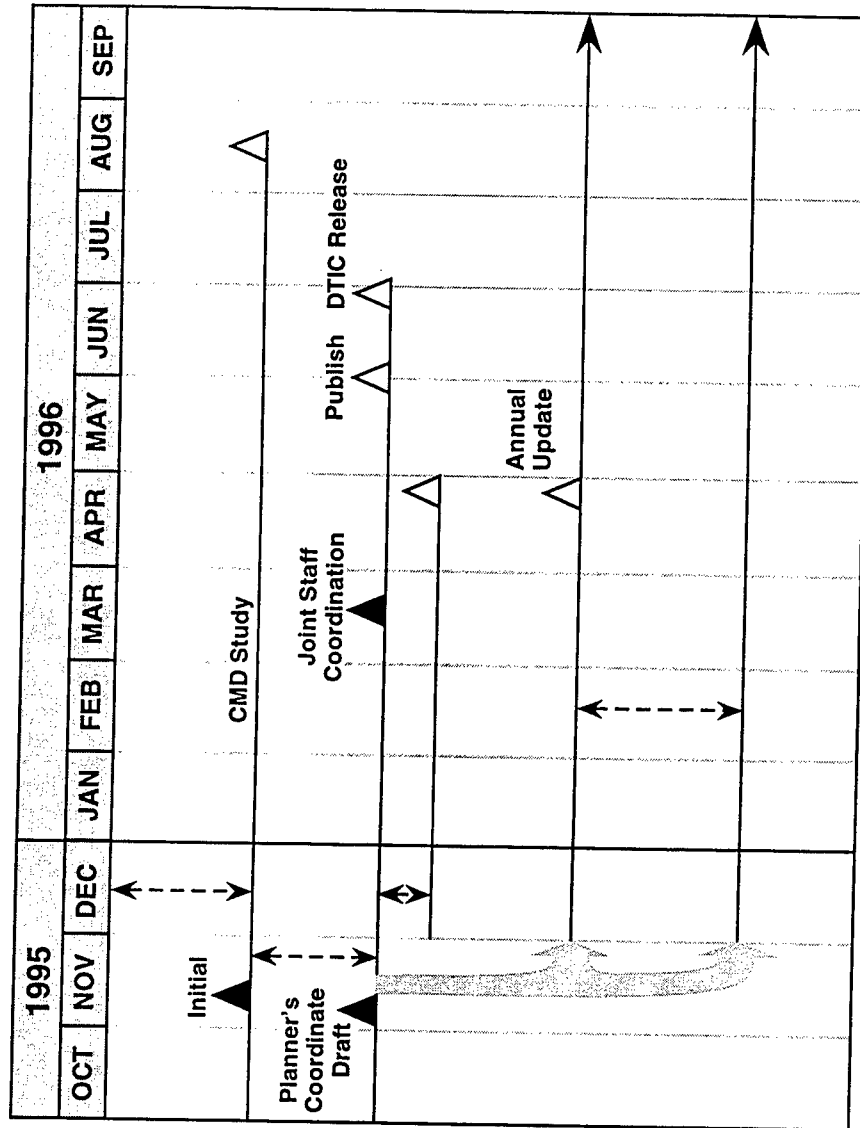
# TMD C<sup>3</sup> IMPLEMENTATION STRATEGY







# TMD C2 PLAN SCHEDULE



- Special Studies (COEA)
- TMD C2 Plan  
- CMD Annex
- TMD C2 Implementation Plan (BMDO)
- TAD C2 Plan (EA TAD BM/C4I)





## SUMMARY

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- TMD C<sup>2</sup> Plan To Be Released Through DTIC - June 1996
  - Full Service Participation
  - Integrated User - Developer Team
- TMD C<sup>2</sup> Plan Provides Road Map To Meet Warfighter Needs
  - Identifies Key Development Tasks
  - Prioritizes Tasks
  - Sets TMD BM/C<sup>3</sup> Milestones

**Provides Industry A Long-range Road Map  
For TMD C<sup>3</sup> System Implementation**







# The Ballistic Missile Defense Organization (BMDO) Presents

## A Program Briefing for Industry and Government (PBIG)

Colonel Andrew J. Fallon, USA  
Director, Test and Evaluation BMDO/AQT  
Test and Evaluation Review  
April 10, 1996

### Abstract

This Test and Evaluation (T&E) Review describes the organization, mission, functions, and relationships of the BMDO T&E programs to provide both industry and government representatives a fundamental understanding of the initiatives, challenges and opportunities associated with BMDO T&E. Functionally, the T&E organization includes test planning and coordination, test resources, test evaluation, civil engineering, and environmental compliance. The primary focus is on TMD Family of Systems (FoS) Testing, but responsibilities also include all military construction and environmental compliance as well as staff T&E oversight of all BMDO acquisition programs including the National Missile Defense (NMD) deployment readiness program. The briefing addresses the challenge of finding feasible cost-effective testing solutions while presenting realistic targets, within range constraints, meeting treaty restrictions, mitigating environmental impacts, and instrumenting for and collecting decision-quality information. Testing methodologies encompass all the traditional techniques, from digital modeling through live flight testing; the payoff is in achieving an innovative balance of hardware-in-the-loop testing with live flight scenarios. In the current environment, BMDO decision-makers have responded to system drivers and external constraints by formulating an investment strategy for testing which emphasizes flexibility and mobility, while minimizing infrastructure and reducing costs.



## **AQ Test and Evaluation Directorate -- What We Do For TMD and NMD**

- The Ballistic Missile Defense Test and Evaluation Program assesses technical effectiveness and the degree to which system functionality and performance meet operational requirements. The T&E Program is structured to reduce acquisition risk, to verify attainment of technical performance objectives, ensure that systems are operationally effective and suitable, and to provide essential and timely information to support decision-making. The Test and Evaluation Directorate within BMDO is structured to achieve these objectives. Under the Director for Test and Evaluation, four Assistant Directors provide for the major functional activities of Test Planning and Coordination; Test Evaluation; Test Resources; and Civil Engineering and Environmental Compliance.
- BMD T&E objectives will be achieved through coordinated developmental and operational test and evaluation planning, efficient test resource management, responsive test support, and a comprehensive independent evaluation program. The BMDO T&E Directorate also provides Civil Engineering services for siting and construction of facilities and environmental compliance for BMDO's acquisition and technology programs.
- Our primary focus is on NMD deployment readiness and TMD Family of Systems testing to increase TMD capability overall. For both, we lead the efforts to plan, resource, execute and evaluate System Integration Testing. We also manage the consolidated targets program, the overall lethality program, other multi-user test resources, and military construction and environmental compliance for all of BMDO .



## **Overall T&E Strategy**

- The Ballistic Missile Defense Organization has evolved an overall strategy for test and evaluation which is comprehensive, progressive and responsive to the fundamental objectives of reducing risk and providing information for decision makers.
- The individual major defense acquisition programs (such as the Patriot Advanced Capability 3, the Theater High Altitude Area Defense, and the Sea Based Area Defense) follow the model on your left. The Live Fire T&E emphasis in each of the MDAP programs is focused on quantifying interceptor lethality against expected threats
- The phased acquisition of TMD, based on MDAP-level decisions, requires system-level tests and test tools to establish and evaluate technical issues, and to assess and confirm integration and interoperability as the developed family of systems evolves and matures. The TMD theater level includes software and communication links between systems, complex message traffic, and BMC3 decisions.
- At the theater level, interoperability and performance of the family of systems will be assessed using a combination of methods including analysis with digital models, simulations and war games, CINC assessments, hardware-in-the-loop tests using the TMD System Exerciser, C3I Integration Tests (C3IITs), and live flight System Integration Tests (SITs).
- Analysis and simulations are used extensively to help define system requirements and theater capabilities. They can be done relatively quickly and at the least cost per test.
- Test tools, such as the TMD System Exerciser (TMDSE), will be used in conjunction with other exercises/experiments to examine complex issues such as architectures, interfaces, and concepts of operation in detailed environments and stressing scenarios where live testing alone would be prohibitive. TMDSE support of C3IITs will rehearse scheduled SITs and provide the means to explore capabilities at the outer boundaries.
- The limited number of live flight SITs will demonstrate that systems will interoperate under tested conditions and will provide the means to validate simulations and test tools. SITs are complex and limited in number by high costs.



## **TMD Risk Reduction Through Early Comprehensive Testing**

- The event-driven schedule depicts the progression of Theater Missile Defense (TMD) Major Defense Acquisition Programs (MDAPs) and TMD Family of Systems integration tests as related to program risks.
- Prior to FY1996, early Extended Range Interceptor (ERINT) and PATRIOT Multi-mode tests were conducted in parallel to determine the preferred configuration for subsequent PAC-3 development. Also displayed are early TMD integration tests and demonstrations being conducted using early warning data. Element flight testing of the Navy Standard Missile-2 Block IVA and Army THAAD and PAC-3 flight testing is depicted later on the schedule. To support integration among elements, System Integration Tests (SITs) and Hardware-in-the-Loop integration tests using the Theater Missile Defense System Exerciser (TMDSE) are planned during the FY96-FY00 period. As you can see, the pace of testing begins to intensify in the FY96-97 timeframe. TMD Family of Systems testing is defined in the TMD Capstone TEMP and, in more detail, in the Integrated Test Plan (ITP).
- Commander-in-Chief's (CINC's) exercises have also been used during the early years of TMD testing and integration. These exercises use current hardware to confirm or try out new operational concepts and add significant knowledge about the way we intend to fight. These exercises will continue to play an important integration role in the FY97-02 time period.
- In order to reduce program risk and develop confidence in family of systems integrated performance, a wide variety of tests must be conducted across each of the operational and environmental conditions expected. To achieve this objective at an affordable cost, Flight Tests will be augmented by Hardware-in-the Loop (HWIL) testing using a Test Tool called the Theater Missile Defense System Exerciser (TMDSE).



## **NMD Readiness Program**

- The current National Missile Defense (NMD) program has been structured to achieve deployment readiness objectives. This activity is supported by an event-driven test and evaluation schedule. As such it is more than a technology demonstration but less than a full acquisition program. Depicted at the top of the chart are the major system tests, including flight and ground tests using the primary NMD test tool, the Integrated System Test Capability (ISTC). The early flight tests (IFT 1-4) will use surrogates to represent the Ground Based Radar (GBR), the Early Warning Radar (EWR), the Space and Missile Tracking system (SMTS), and the Battle Management/ Command, Control, and Communications (BM/C3). The major NMD system verification test will be conducted around IFT 5. Actual NMD elements will be integrated during this test.
- The ISTC is being developed on an incremental basis. The initial two ISTC validation tests have been conducted with good results. ISTC Validation tests will continue into FY98 and after the Integrated Ground Test Two (IGT 2) campaign in FY99, IGTs will precede the IFTs in following years. Over time, the ISTC will be migrated to the National Test Facility (NTF).
- Also displayed are NMD element test schedules for the Ground Based Interceptor (GBI), GBR-Prototype, Upgraded EWRs, BM/C3 and the Interceptor's In-Flight Integrated Communication System (IFICS), and SMTS.



## **Test Planning**

- The Ballistic Missile Defense Organization has evolved an overall hierarchy of test planning documentation to coordinate and formalize the planning process.
- The first level is the Test and Evaluation Master plans. TMD Family of Systems test planning is captured in a Capstone TEMP. The individual major defense acquisition programs (such as the Patriot Advanced Capability 3, the Theater High Altitude Area Defense, and the Sea Based Area Defense) all have classic TEMPs which define the approved T&E programs.
- At the TMD theater level, interoperability and performance will be assessed using a combination of analysis, simulations and war games, hardware-in-the-loop tests including C3I Integration Tests (C3IITs), various exercises and experiments, and a limited number of live flight System Integration Tests (SITs).
- The next level of detail is the Integrated Test Plan or ITP. ITPs are published or in work for each major program, for the Family of Systems testing and for Joint Demonstrations. Detailed Test Plans are prepared to define the finite detail of all test events and the specific elements of data which must be collected to answer critical questions and provide relevant and useful information to decision makers.



## **Test Evaluation -- Why**

- The test evaluation function is actively engaged in parallel with the test planning function throughout the whole process of planning, executing and reporting. It spans all the blocks in the T&E strategy and it addresses the whole spectrum of BMD systems.
- This approach facilitates two primary objectives of evaluation: resolving ambiguities and detecting problems early.
- Because the evaluation function spans the domain of BMD systems at all levels of the Test strategy, evaluators are able to provide additional information learned across the spectrum of testing, which is integral to the resolution of ambiguities which frequently arise during execution. There is an important preventive aspect of the evaluation function also; that is cross sharing lessons learned across the family of systems.
- The second objective is to detect problems at an early stage when there is time to formulate alternatives and correct problems more easily. With the significant emphasis on fielding BMD systems as a matter of national importance, the early detection and resolution of problems reduces both technical and schedule risk.



## **Test Evaluation**

- The mission of the BMD Consolidated Evaluation Program (CEP) is the execution of analyses and evaluations which contribute to the development of the BMD Family of Systems (FOS) and ultimately to the successful achievement of acquisition milestones. The CEP process examines both the performance of multiple individual weapon systems acting together in a unified ballistic missile defense and the performance of individual weapon systems aided by external cueing. The CEP will establish confidence in overall system-level performance and the sensitivities in the confidence by ascertaining and evaluating the confidence established by the individual weapon system performance evaluations.
- The role of the BMD CEP process encompasses Technical Monitoring (TM) and Performance Evaluation (PE). TM includes surveying programmatic activity, reviewing documentation, analyzing designs, and conduct of special studies to understand performance potential and limitations. It is the principle means of obtaining in-depth insight into the technical features of the individual weapon systems under development and their relationships within the Family-of-Systems. It also involves monitoring all test programs and reviewing all analyses and evaluations promulgated during the development process. PE is an on-going analysis and regular assessment of FOS performance, executed to enable tracking of FOS performance effectiveness in negating Reentry Vehicles (RVs), to build confidence in the validity of these performance estimates and to understand FOS-Level performance drivers. The objectives are to minimize the risks associated with achieving successful performance at the FOS level and avoid technical surprises during the FOS development.
- Tracking and evaluation of performance effectiveness at the Family-of-Systems level is the long-term objective of the CEP process. The CEP activities are intended to support informed technical and acquisition decision-making.



## **Information Path to Decision Makers**

- The Test Evaluation function provides information to support informed decision making at all levels.
- System integration testing (such as TMD family of systems flight testing) and system hardware in the loop testing (with the TMD systems Exerciser) are structured to support the operational assessment process by which the Director, Operational Test & Evaluation meets statutory requirements for informing Congress. It also feeds war games, CINC Assessments and other force level assessment processes
- Systems operational assessment and force level analysis both support the periodic preparation of a consolidated evaluation report. BMDO will provide this report to support informed decision making in the legislative processes affecting BMDO programs.



## **Historical Flight Test Programs**

- Missile flight test programs focus on demonstrating system capability under projected operating conditions and acquiring confidence that the system will meet specified reliability requirements
- Cost, and system evolution considerations, have historically precluded conducting the hundreds of trials required to achieve high statistical high confidence in a systems ability to satisfy high reliability requirements
- An understanding the failure mechanisms identified during the prior missile programs, evolution of the models and simulation technology developed for these programs, and application the data collected during flight test portions of these programs has been used to reduce the number trails needed to obtain a given level of systems confidence.
- Factors limiting the trend toward fewer tests include: the requirement for incremental testing for fault isolation and risk management, the number of different environments in which the system must operate and extent to which existing systems and/or technology has been successfully tested in these environments.



## **Test Process and Methodology**

- The phased acquisition of TMD, based on MDAP-level decisions, requires system-level tests and test tools to establish and evaluate technical issues, and to assess and confirm integration and interoperability. The TMD theater level includes software and communication links between systems, complex message traffic, and a variety of BMC3 decisions.
- At the TMD theater level, interoperability and performance will be assessed using a combination of analysis, simulations and war games, hardware-in-the-loop tests including C3I Integration Tests (C3IITs), various exercises and experiments, and a limited number of live flight System Integration Tests (SITs).
- Analysis and simulations are used extensively to help define system requirements and theater capabilities. They can be done relatively quickly and at the least cost per test.
- Test tools, such as the TMD System Exerciser (TMDSE), will be used in conjunction with other exercises/experiments to examine complex issues such as architectures, interfaces, and concepts of operation in detailed environments and stressing scenarios where live testing alone would be prohibitive. TMDSE support of C3IITs will rehearse scheduled SITs and provide the means to explore capabilities at the outer boundaries.
- The limited number of live flight SITs will be used to build confidence in the basic soundness of test approaches by demonstrating that systems will interoperate under tested conditions as well as provide the means to validate the simulations and test tools used to evaluate system performance across the various TMD theater operational configurations and stressing threats and environments. SITs are complex and limited in number by high costs.



## **New Directions**

- As the threats, the defense environment and the program directions have evolved over the last few years, the process and direction associated with T&E resources has been redirected and retooled as well.
- A number of resource drivers have emerged which tax the traditional test range and instrumentation capability. For example, system performance improvements have come from the application of improved sensors, better focal planes, and more accurate guidance, navigation and control technology which enable the application of kinetic kill vehicles and resulting improvements in lethality. Assessing improved performance drives the need for higher precision and accuracy instrumentation.
- At the same time that systems complexity and other drivers were pushing test resources capability, the defense budget has been shrinking and the services have been downsizing. These factors in combination have put significant pressure on the defense testing infrastructure, otherwise known as the Major Range and Test Facility Base (MRTFB).



## • **BMDO Sponsored Test Facilities**

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- The BMDO sponsors several ground test facilities to support the testing of BMDO programs and technologies. The Test and Evaluation Directorate (AQT) funds the operations and maintenance of these capabilities and provides guidance on facility upgrades, VV&A, and potential users. The primary purpose for the funding of these facilities is to provide responsive capabilities in place and available to meet program needs.
- BMDO supports these facilities because ground testing can have a significant risk reduction effect on flight test programs. If only one flight test is saved from failure through comprehensive ground testing, then the facility has justified its expense.
- These facility capabilities include: closed loop Hardware-in-the-Loop (HWIL) testing of IR seekers from sensor handover through endgame; hypersonic aerodynamic, aerothermal, aero-optic, and lethality (hit-to-kill) testing of interceptors; testing and characterization of IR seekers in space environments; Telemetry, Tracking, and Control (TT&C) of satellites and space-borne experiments; hover and captive testing of kill vehicles to test attitude control systems; range support of missile test fueling operations; creation and archival of threat and interceptor models and simulations; and the establishment and maintenance of low-background IR calibration standards.

- *For More information on each ground test facility see pages 22-30 in the Backup section*



## Target Inventory

- The Consolidated Targets Program is structured to satisfy requirements of both the Theater Missile Defense (TMD) and the National Missile Defense (NMD) arena. TMD targets represent threats in the range of less than 3500 km in range and less than 5 km/sec reentry velocity while NMD threats are usually beyond those ranges.
- LANCE - The Lance is a two stage liquid fueled surface-to-surface battlefield support missile originally deployed the US Army. The Lance has capabilities to fly ranges of 8 to 130 km, depending on Reentry vehicle weight.
- STORM - The Storm target is a two stage solid fueled booster system made up of spare Minuteman assets with the capability to fly ranges between 100 and 500 km . It was developed by Orbital Sciences Corporation and has supported both the PATRIOT and THAAD systems.
- HERA - The Hera target system is also a two stage solid fueled booster system made up of spare Minuteman assets. It was developed by Coleman Research Corporation to be the primary target system for the PAC-3 and THAAD interceptor systems. The Hera represents medium range threats up to 1150 km.
- There is a need for a Long Range Target on the order of 2000 to 3500 km in range. The most favored option is the two stage winged Air Launch delivery system. This target would fulfill requirements of the THAAD and Navy Upper Tier programs. Other options under consideration are the STARS as long range TMD target and a 3-stage Hera piledriver.
- The strategic target system (STARS) was designed by Sandia Labs; it can fly ranges of up to 4000 km. STARS support the Midcourse Space Experiment (MSX).
- The Multi-Service Launch System (MSLS) is a Minuteman II Inter Continental Ballistic Missile (ICBM) with an upgraded Reentry vehicle. The MSLS is being developed by Lockheed Martin. It has the capability to fly intercontinental ranges of up to 7800 km. It will be the primary target for the Exoatmospheric Kill Vehicle (EKV) testing.
- The BMD targets program also provides foreign threat systems as targets.



## **TMD Test Range Alternatives**

- Theater Missile Defense testing requires a wide range of scenarios to test the interceptors against threat representative targets. Most of the shorter range test scenarios can be conducted at White Sands Missile Range(WSMR), however for safety and other considerations, longer range and complex test scenarios are planned for overwater target paths and intercepts.
- Construction projects are underway to build target launch facilities at Fort Wingate in New Mexico and Wake Island. Although an air launch target capability is being pursued, the development of remote target launch sites to support TMD testing on the Pacific Missile Range Facility(PMRF) and the Gulf Range at Eglin Air Force Base may be necessary.
- PMRF has been designated as the primary range for Navy TMD testing. However the Navy requires a testing (and training) capability in both the Atlantic and Pacific Oceans. Studies are in progress to determine how best to meet the Navy requirements.



## Instrumentation Assets

- Kwajalein Mobile Range Safety System (KMRSS) is a suite of instrumentation installed on the former USNS Worthy to support missile flight safety for launches from remote locations such as Wake Island. It will be available to support testing in the Summer of 1996.
- Two NP-3 aircraft at Pt. Mugu are being modified to provide a highly mobile range safety system to support target launches. The first aircraft will be operational in the Summer of 1996 and the second in the Summer of 1997.
- Mobile optics are being developed at White Sands Missile Range (WSMR) to gather precision optical data during missile tests. In addition, the 3.5 meter telescope at Apache Point is being modified to collect data at WSMR.
- High Altitude Observatory (HALO) is specially configured Grumman Gulfstream that collects optical data in several wavelengths. Airborne Surveillance Testbed (AST) is a specially configured Boeing 767 that performs a similar mission. These assets are frequently used in conjunction to cover different parts of the mission.
- Rapid Optical Beam Steering (ROBS) system is a unique transportable active/passive sensor that can provide accurate tracking data on multiple closely spaced objects.
- Future instrumentation needs to support BMDO testing include a mobile (either aircraft or ship mounted) X-band radar, Precision Time-Space-Position-Instrumentation (TSPI) to support missile engagement assessments, a Transportable Range Augmentation and Control System (TRACS) which will be suite of instrumentation that can augment existing range instrumentation in the conduct of complex tests, and the concept of a mobile range is being explored.



## **Facilities, Siting, and Environmental**

- Three primary objectives characterize the goals of the Facilities, Siting and Environmental function.
- The decision on where to site facilities is a major cost driver in the acquisition, operations and maintenance of both RDT&E and operational facilities. Our objective is to achieve reduced costs through effective siting.
- The second major objective is to comply with environmental policy and law as a major concurrent activity in all program decision and execution processes.
- The third is to construct only those facilities that are clearly required. We are engaged in satisfying two general types of requirements: those that are required to support operations and operational units, and those which support necessary test programs.



## **Summary**

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- The BMDO Test and Evaluation Mission is to plan and prepare for, to execute, and to evaluate the testing of the ballistic missile defense program. The scope of the BMD program is comprehensive -- it includes the individual acquisition programs, as well as the integration and family of systems.
- The mission also includes facility construction and environmental compliance of BMD programs across the full range of research, development, test and evaluation, and acquisition. activities.



## **Backup #1 -- Civil Engineering and Environmental Initiatives & Opportunities**

- Various THAAD launch facilities such as launch pads, physical security items, plus supporting utilities will be required. Some of these are being provided already under a Navy design/build contract at Wake Island but other locations will be considered in the future and will appear in the CBD.
- One missile assembly building and two trailer safety shelters will be required at WSMR to support the THAAD and PAC-3 programs. Both have been authorized for design and may be announced in the CBD if WSMR chooses to open competition instead of using local installation on-call contractors.
- THAAD 1st Battalion facilities at Fort Bliss, to include THAAD/GBR training and maintenance facilities, POL storage and fueling station, pavement for vehicles, and supporting utilities and physical security, will be required.
- A number of facilities will be required at the Kwajalein Missile range to support both NMD and TMD activities.
- Use the BMDO Acquisition Reporting Bulletin Board by dialing (703) 769-8394 to see the CBD and RFP.



## **Backup #2 -- Test and Evaluation Conundrum**

- The challenge facing the BMDO T&E community is finding a feasible and affordable solution to a number of challenges.
- The physical limitations of the national ranges and limited capabilities of existing range instrumentation are not sufficient to achieve a full, realistic test environment and to assess performance and suitability without considerable effort. We have been and will continue to develop flexible and mobile instrumentation and data collection capabilities to meet test requirements.. Mobile sensor platforms, high performance optics, mobile range safety, global positioning technology, and air launched targets are some of the innovative technologies we are pursuing to meet testing challenges.
- The area of Targets also presents similar challenges. The Director, BMDO has established a Consolidated Targets program designed to strike the proper balance between cost, program phase and requirements, and target presentations which are fully representative of threat systems in all respects, including reentry velocity, trajectory, signature, temperature, RCS, and phenomenology. Because launch of ballistic missile targets requires an expensive infrastructure, we are developing an air launch option which would enable a wide variety of launch locations and orientations without the attendant infrastructure bills.
- The environmental challenges of TMD and NMD testing are considerable. The Director, BMDO takes very seriously the responsibilities of compliance with the National Environmental Policy Act and we have instituted a comprehensive NEPA compliance program. We strive to be good and responsible neighbors in locations where testing is contemplated.
- And of course, existing treaties limit various options for test conduct.



## **BMD Ground Test Facilities - More Detailed Backup Information**

- AEDC 7V/10V Space Chambers, Arnold Engineering Development Center, Tullahoma, TN  
The 7V Space Chamber provides a capability to characterize and calibrate surveillance and interceptor sensors in a space environment. The chamber is a horizontal cylindrical shell 7-foot in diameter by 23-foot long. Within the vacuum shell, the key structural element is a helium cooled Optical Bench. For ease of access to the equipment, the bench is mounted on rails so it can be inserted or removed quickly from the chamber. In addition, the test section can be opened while the rest of the chamber is still in cryovacuum, allowing for quick and easy access to test articles. The Environmental Systems provide vacuum and cryogenic conditioning, utilities, and contamination monitoring. The 7V chamber recently completed a series of sensor tests in support of the EKV program.

The primary purpose of the 10V Space Chamber is to provide the ability to fully test integrated sensor systems in checking interfaces and assure that the system can perform mission tasks. This includes surveillance satellite testing with realistic earth background scenes. This requires a scene projector system which can provide adequate scene content with the required fidelity to exercise the sensor and its associated data processors as they perform the critical tasks of the mission. The design of the test chamber is also influenced by the design of the sensors which will be tested. The chamber can also support two sensors at once using a scene splitting arrangement. The 10V chamber will achieve initial operational capability late in FY96.

AMOR, Army Missile Optical Range, Redstone Arsenal, Huntsville, AL  
AMOR is a unique Optically Constructed Far-Field facility where far-field, calibrated laser radar signatures of full sized (up to two meters) targets can be measured. Realistic target motions are provided which allow dynamic visualization of data and evaluation of target discrimination algorithms. While AMOR was designed for active sensor signature



measurements, simultaneous passive measurements have been demonstrated through its high quality optical train. AMOR does not provide a sensor calibration function; however, it does provide a controllable engagement environment with measurable parameters, allowing accurate assessments of both a test sensor's characteristics and discrimination algorithm's functionality. Real sensors can be tested at AMOR. While AMOR is not a radiometric calibration facility, the sensor environment can be manipulated to provide low level target and background signals. Under these conditions, specific sensors (with their peculiar noise characteristics) can be tested along with specific targets (with their peculiar emissivity characteristics). Upgrades planned for FY96 include the installation of a zoom optical system to simulate interceptor end-game, an environmental chamber for test sensors, and additional heated targets.

#### AOEC LENS, Aero-Optic Evaluation Center Large Energy National Shock Tunnel, Buffalo, NY

The Large Energy National Shock (LENS) tunnel has been constructed to duplicate the airflow around seeker head prototypes for velocities from 1 to 5 km/sec at altitudes between 10 and 60 km with run times up to 25 milliseconds. A suite of aero-optic and aerothermal instrumentation has been designed, fabricated, and tested which will enable the evaluation of the aero-optic distortions and the radiation levels generated in the shock layer over a full-scale interceptor seeker head. AOEC has recently completed an upgrade to allow the LENS facility to operate with Hydrogen as the driver gas and AIT contractor testing is scheduled to start in late FY95. Calibration of the facility is in progress.

#### Captive Carry, Nevada Test Site

The Captive Carry facility is a 1527 foot tall structure at the DOE's Nevada Test Site. It can be used to test the guidance, navigation and control functions of a prototypical interceptor. Zero gravity conditions are simulated in one dimension by suspending the test vehicle from a long, light-weight tether. By locating the tethered vehicle on a flat optical range, a target simulator can be employed to simulate the very high closing velocities planned for



intercept demonstrations in space and the atmosphere. Captive flights can facilitate a systematic evaluation of attitude control, intercept guidance, and center of mass control for interceptor vehicle propulsion and seeker systems. The Captive Carry Facility is currently held in mothball status, but may be reactivated to support the Atmospheric Interceptor Technology Program.

CERES. Center for Research Support, National Test Facility, Falcon AFB, CO  
Upon completion of a major upgrade in early FY96, CERES will be able to provide enhanced experiment support, including communication links, telemetry, tracking, and commanding systems (TT&C) capability. Software to support orbital analysis, satellite and ground resource scheduling, and quick-look analysis has been purchased and/or developed primarily from commercial-off-the-shelf equipment. These software and hardware tools were designed to be user friendly, adaptable, and satisfy requirements of multiple supported programs. CERES is intended to provide the capability to support the common requirements between multiple programs, but is not limited to the area of payload support of orbital flight tests. Thus, it can support both technology and element programs. Upon completing, CERES will have the potential to support NMD/LEAP BMC3, SMTS, MSTI, and Milstar programs.

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KDEC. Kinetic Energy Weapon Digital Emulation Center, USASSDC, Huntsville, AL  
The KDEC provides a suite of analytical digital models supporting a multilevel test capability that supplements interceptor ground and flight tests for risk and cost reductions. It has a collection of validated six degrees-of-freedom modules of kinetic energy interceptors suitable for testing a wide variety of sensors, controls, flight phases, warheads and boosters. These components may be individually tailored for a specific test article or complete interceptor subsystem in a test environment for technology development and functional technology validation. The user selection of input parameters and output responses is made easy through the window manager, thus reducing analysis turn around



time. The user may also interactively control the start, stop, pause, and continuation of simulation runs and modify on-line the input parameters for the test articles. Recently, KDEC has created a home page on the Internet's World Wide Web, where unclassified data and documents are available to the general public.

KHILS. Kinetic Kill Vehicle Hardware-in-the-Loop Simulator, Eglin AFB, Fort Walton Beach, FL The KHILS is part of a non-destructive HWIL testing laboratory for guided weapon systems and components. The facility performs high-fidelity modeling of system functions and non-hardware processes to exercise the integrated flight hardware of Kinetic Energy Weapon interceptor concepts in a HWIL environment. KHILS consists of computational resources, environmental chambers to minimize atmospheric attenuation effects in the scene projector/seeker radiation path, target scene projection systems to present in-band imagery to the interceptor seeker, and the flight motion simulator (FMS) to provide relative target/seeker angular motion and stimulate the interceptor rate sensors. A KHILS simulation includes actual interceptor hardware and software integrated into the KHILS test environment to perform the majority of the onboard guidance, navigation, and control (GN&C) functions.

With the Wideband Infrared Scene Projector (WISP) program at KHILS, a new state-of-the-art technology for high fidelity IR sensor testing is being developed. The WISP will provide high dynamic range, broad band, dual color images for the real-time hardware-in-the-loop testing of interceptor seekers. Scenes that the WISP is designed to project include target and background phenomenology effects from boost phase through reentry. Staging effects and missile breakup with debris as well as the earth, clouds, and horizon at various spatial and spectral resolutions will be projected. KHILS has recently initiated Phase III for the development of the WISP. This phase will produce several arrays for testing at KHILS and finalize the design. WISP achieved an initial operational capability in the 4th quarter of FY95 and full operational capability is expected in the 3rd quarter of FY96.



## MOSTT/NRaD. Mosaic Optical Sensor Technology Testbed / Navy Research and Development IR Devices Branch

MOSTT is actually a combination of two facilities, the Characterization of Low Background

Mosaics (CALM) and the Portable Optical Sensor Testbed (POST). These facilities, while owned by the Government, are operated by Rockwell International in Anaheim, CA. The role of these two facilities is to provide for the evaluation and calibration of IR sensors and their components. These facilities are currently involved with EKV sensor testing.

CALM is a low to moderate background focal plane array test facility. Focal plane systems can be maintained at 5° K while all sources and optics are kept in a high vacuum chamber at 20° K. In operation, CALM provides an imaged infrared spot which is scanned across the mosaic array or chip under test.

The POST is a low to moderate background IR sensor test chamber which can evaluate complete sensors. It is capable of producing three source signatures and 15 targets. The most useful POST capability is its portability, allowing it to be transported to the other test facilities.

25 The IR Devices Branch of the NRaD facility is a reliable, independent government test agency for the evaluation of IR sensor components and materials. It is used to develop state-of-the-art measurement and analysis techniques for sensor component technology. It can, also accomplish real time nuclear effects evaluation of focal plane arrays, filters, and materials. Through FY95-97 contractors will be attempting to reduce risk and cost of the EKV.

## NHTF, National Hover Test Facility, Edwards AFB, CA

The NHTF is a uniquely qualified facility for the purpose of static and flight testing of space and airborne integrated flight vehicle systems. It is responsible for validating interceptor propulsion engines and characterizing the vehicle's structural stability by testing Kinetic Kill Vehicle (KKV) divert thrust and attitude control systems and evaluating the associated body dynamics. This contributes significantly to preflight risk reduction and allows the



assessment of optical jitter due to the propulsion system. Targets at the facility include live rocket motor firings of scaled ICBMs (an external plume-hardbody IR target simulator), orbiting space objects which are viewed through a satellite tracking system, and heated target test stands to simulate IR targets. The NHTF also provides propellant loading expertise in support of range operations. NHTF recently supported propellant loading for the THAAD FTV-1 and FTV-2 flights at WSMR. NHTF will continue to support THAAD flights through FTV-6.

NIST LBIR, National Institute of Standards and Technology, Low-Background IR Calibration Facility, Gaithersburg, MD

The NIST LBIR facility consists of two low-background cryogenic vacuum chambers for IR measurements. One is fully operational and is used for broadband measurements of IR sources and materials in a liquid helium cooled 20 degree K background. The other chamber is currently being developed to provide low-resolution spectral measurements in a variable temperature (room temperature to 20 degrees K) vacuum to simulate a high altitude environment. Spectral capability will initially cover the 2 - 30 micrometer band with future capability to 50 micrometers. The spectral chamber will achieve an initial operational capability in early FY96.

The LBIR facility is currently used for broadband calibration of blackbody sources for the major BMD IR test facilities, MSX calibration spheres, and other broadband measurements as required. The spectral capability will enable spectral calibration of blackbodies, MSX spheres, IR detectors, spectral filters, windows, and optical materials for numerous BMD applications.

NIST is also conducting broadband and spectral IR measurements of two samples of optical Garnet material obtained from the Former Soviet Union through a Broad Area Announcement contract with BMDO/AQT. Garnet is a candidate material for high speed interceptor windows. The final report on the NIST testing will be available shortly for dissemination to the BMDO community.



AEDC Range G, Arnold Engineering Development Center, Tullahoma, TN

The Hypervelocity Ballistic Range G facility is currently in Phase I of a proposed three phased upgrade program to enhance the facility's ability to fire large projectiles (8 inch diameter, 8 kg mass) at high velocities (4 km/sec). This increase in projectile size and mass will allow Range G to perform lethality testing with the THAAD-representative half-scale Medium Mass Interceptor (MMI) at actual intercept closing velocities. The THAAD Program Office has allocated two targets for lethality testing at AEDC. Phase I was successfully completed late in FY 95. Phase II will develop a full operational capability for a zero model angle and consist of five shots. Phase III will add controllable model attitude to the full operational capability with an additional nine shots. The schedule calls for completion of Phase III within three months of Phase II initiation.

Tunnel 9, Naval Surface Warfare Center, White Oak, MD

NSWC Hypervelocity Wind Tunnel 9 provides uniform, clean aerodynamic flowfields in the critical altitude regimes experienced by strategic offensive missile systems, advanced defensive interceptor systems, and hypersonic transport vehicles. Tunnel 9 supports aerodynamic, aerothermal, jet interaction, and shroud removal testing. The Tunnel 9 facility achieved a full flight duplication capability for the Mach 7 flight regime in 1Q95. Tunnel 9 was selected as the optimal facility to develop a capability in the Mach 7 regime while other facilities were directed to develop capabilities in other critical flight regimes. The current facility schedule shows heavy use by the THAAD Program, as well as the Atmospheric Interceptor Technology Program, and the Arrow Program over the next three years, although budget constraints may limit Arrow testing at Tunnel 9. These requirements have been documented in correspondence between the BMDO and the Department of the Navy.



The White Oak Detachment of NSWC has been slated for closure under BRAC 95. The BMDO, Air Force (AEDC), and DNA are exploring avenues for the continued operation of Tunnel 9 after it is abandoned in place by the Navy in January, 1997.



# Test And Evaluation Review



April 1996

**Mr. Harry R. Marien**  
**Assistant Director, Test And Evaluation Directorate**  
**Acquisition / Theater Missile Defense Deputate**  
**Ballistic Missile Defense Organization**





# TEST AND EVALUATION DIRECTORATE

## WHAT WE DO FOR TMD AND NMD

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### *Test Planning And Coordination*

Test And  
Evaluation  
Master Plans

FOS

Integrated  
Test Plans

### *Test Resources*

Instrumentation  
Targets  
Ground  
Facilities  
Ranges

### *Test Evaluation*

Consolidated  
Evaluation  
Reports

Independent  
Evaluation

Technical  
Monitoring

*Civil Engineering  
And  
Environmental  
Compliance*

- Primary Focus On NMD Is Deployment Readiness
- Primary Focus On TMD Is Family Of Systems
- For Both
  - System Integration Testing
  - Support Acquisition Programs In T&E
  - Manage Consolidated Targets And Lethality Programs





# OVERALL T&E STRATEGY

MDAP	Family Of Systems
<p>Component / Subsystem Testing</p> <p>Digital Models / Simulations</p> <p>HWIL</p> <p>Live Fire T&amp;E</p> <p>Flight Test</p>	<p>Digital Models (EADSIM / EADTB)</p> <p>War Games</p> <p>CINC Assessments</p> <p>TMD System Exerciser (HWIL)</p> <p>System Integration Test</p>

J N T F





### Projected Schedule







# NMD READINESS PROGRAM

	FY 96				FY 97				FY 98				FY 99				FY 00				FY 01				FY 02				FY 03				FY 04			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4				
• System Milestones	NMD SRR △				NMD IPR △				Design Reviews (Early) △				Readiness Review △				IPRs △																			
• System Tests																																				
- Flight Tests																																				
- Ground Tests																																				
• GBI																																				
- EKV Development																																				
- Booster Development																																				
- GBI Integration																																				
• Radar																																				
- GBR Prototype																																				
- Existing Sensors																																				
• BM/C <sup>3</sup>																																				
- BM/C <sup>3</sup>																																				
- IFICs																																				
• SMTS																																				
- FDS																																				
- Pre-EMD																																				
- EMD																																				
• Funding (TY \$ In M)	746				500				500				400				300				300				400				400			400				





# TEST PLANNING

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- Test And Evaluation Master Plans
  - MDAPs
  - Family Of Systems (Capstone)
- Integrated Test Plans
  - MDAPs
  - Family Of Systems (HWIL / SIT)
  - Joint Demonstrations
- Detailed Test Plans





# TEST EVALUATION

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*Why ?*

- Gain Additional Information To Resolve Ambiguity
- Find Problems Early To Develop Alternative Solutions

**Goal: Support Informed Decision Making**





# TEST EVALUATION

---

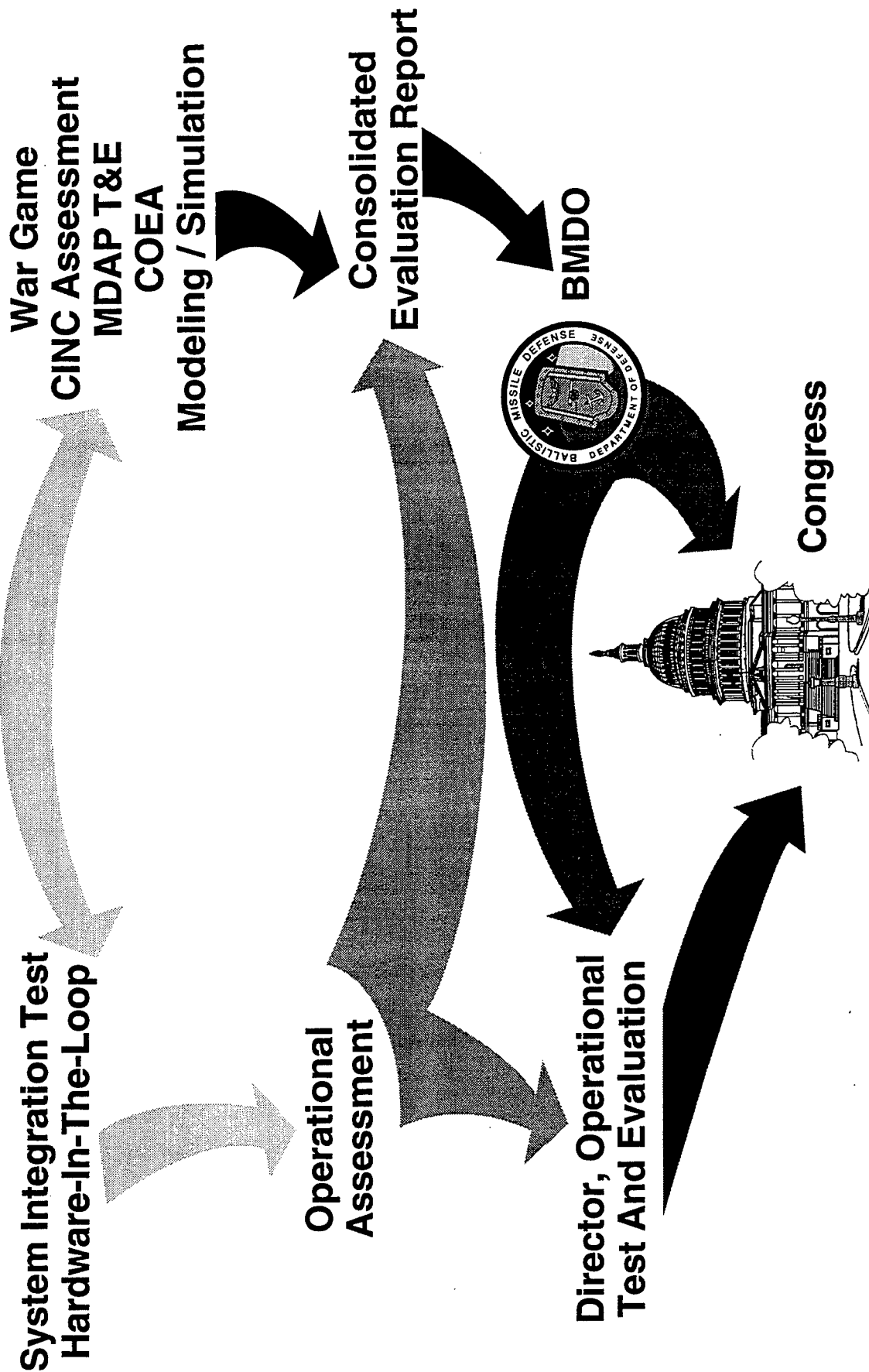
- Gain Additional Data To Resolve Ambiguity
- Find Unknown Problems Early And Develop Alternatives
- Coordinate With Service Operation Test Agencies
- Coordinate Test And Evaluation Working Group
- Perform Independent Evaluation
  - Monitor Individual Program Test Results
  - Coordinate Family Of Systems Evaluation
  - Publish Annual Consolidated Evaluation Report
- Perform Technical Monitoring
  - Parallel System Engineering Process
- Conduct Special Studies / System Analysis
- Publish Test And Evaluation Activity Summary

**Support Informed Decision Making**





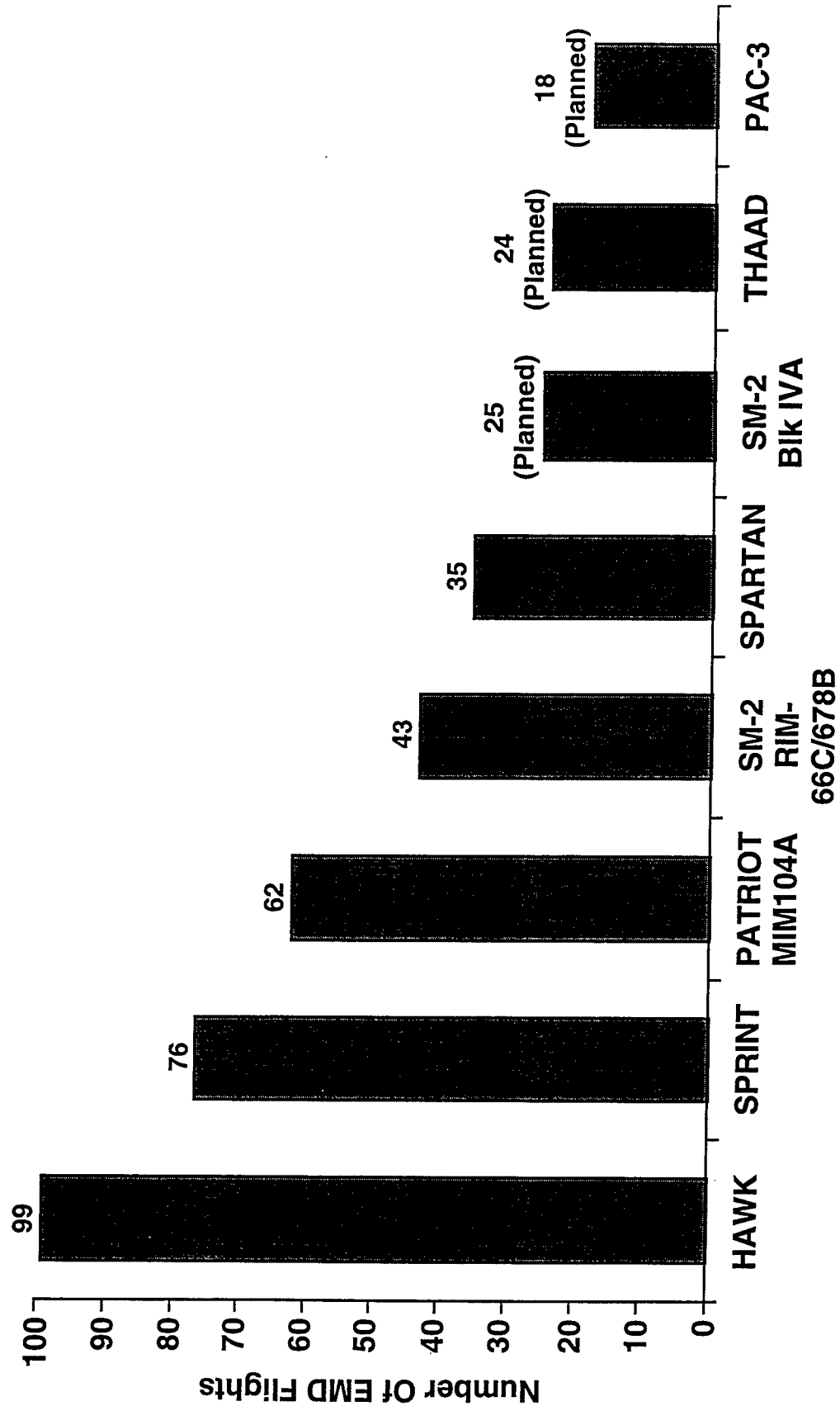
# INFORMATION PATH TO DECISION MAKERS







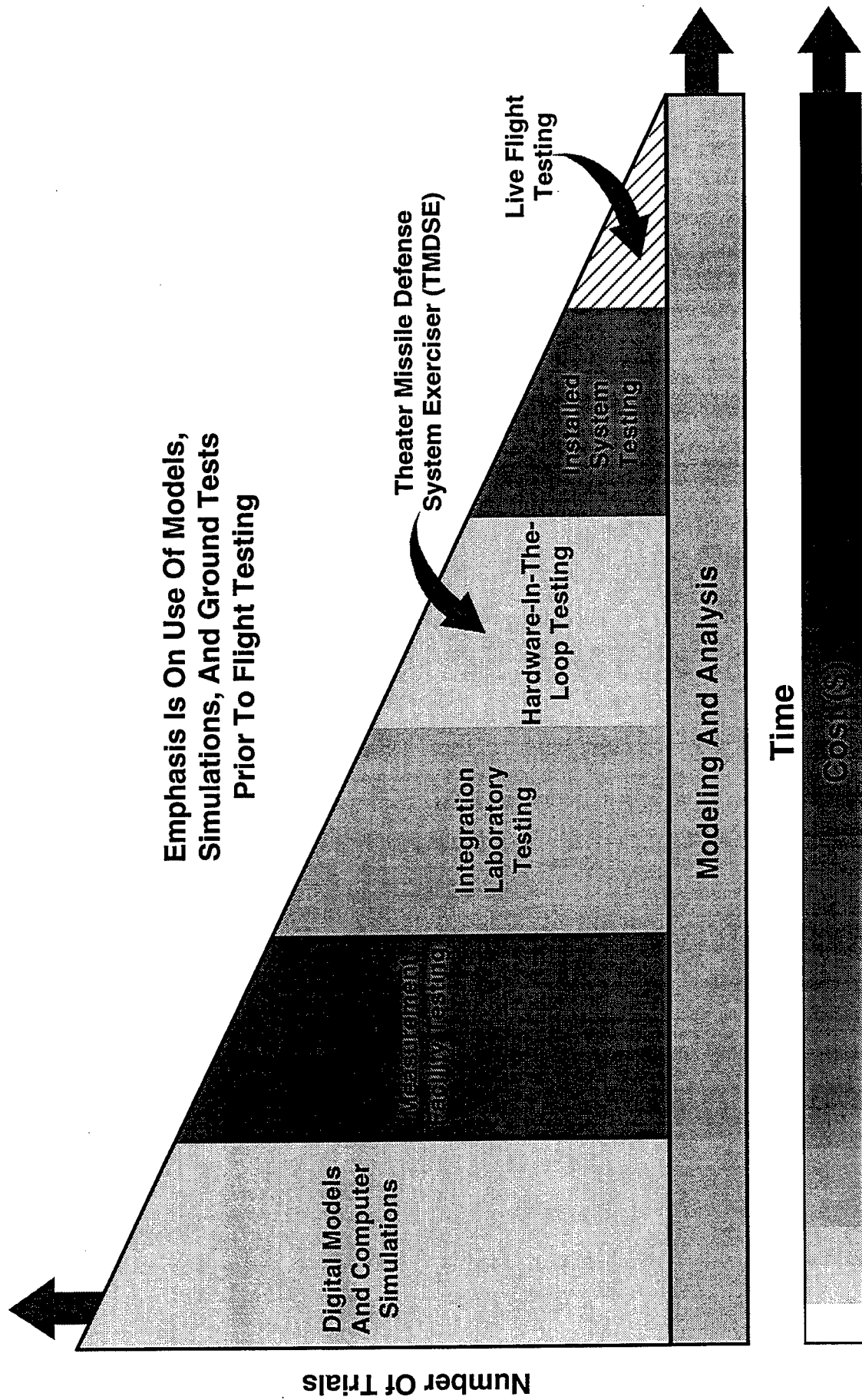
# HISTORICAL FLIGHT TEST PROGRAMS







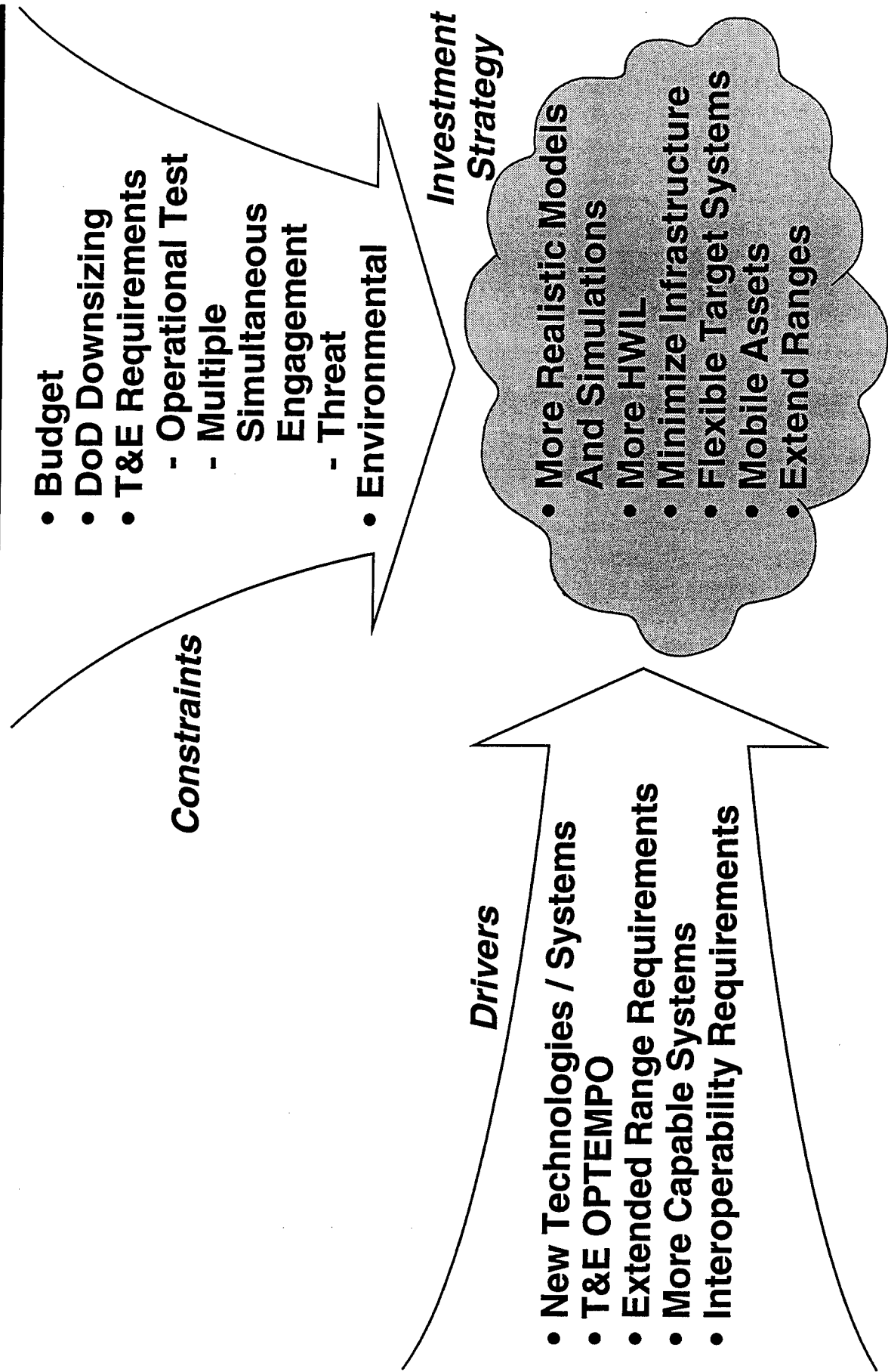
# TEST PROCESS AND METHODOLOGY







# NEW DIRECTIONS





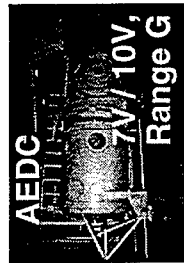


# BMDO SPONSORED TEST FACILITIES

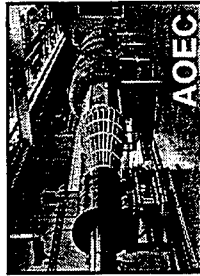
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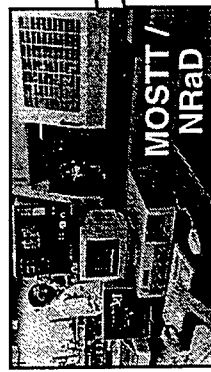
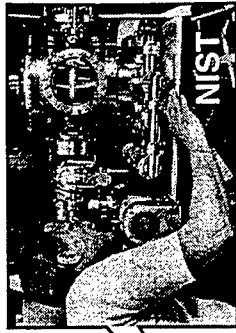
Tullahoma, TN



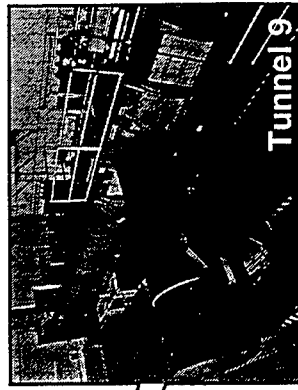
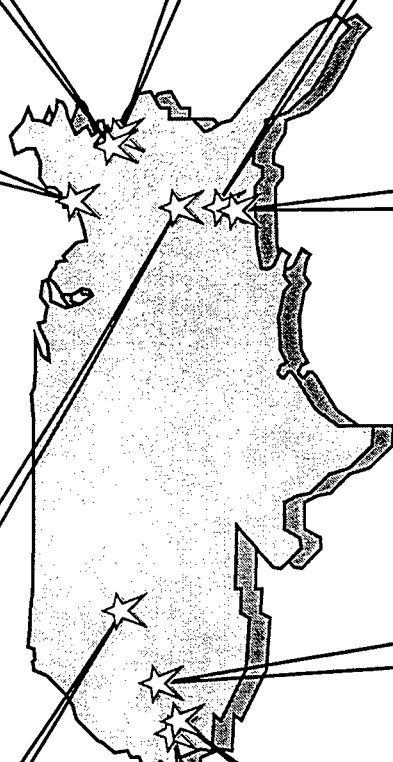
Buffalo, NY



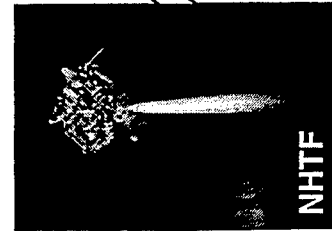
Gaithersburg, MD



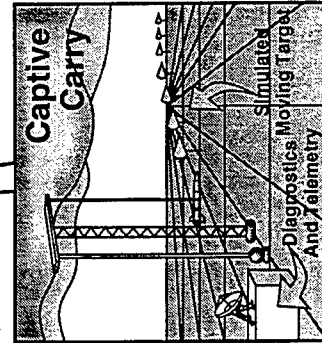
San Diego / Anaheim, CA



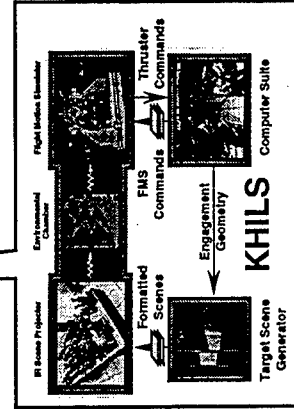
White Oak, MD



Edwards AFB, CA



Nevada Test Site, NV



Eglin AFB, FL

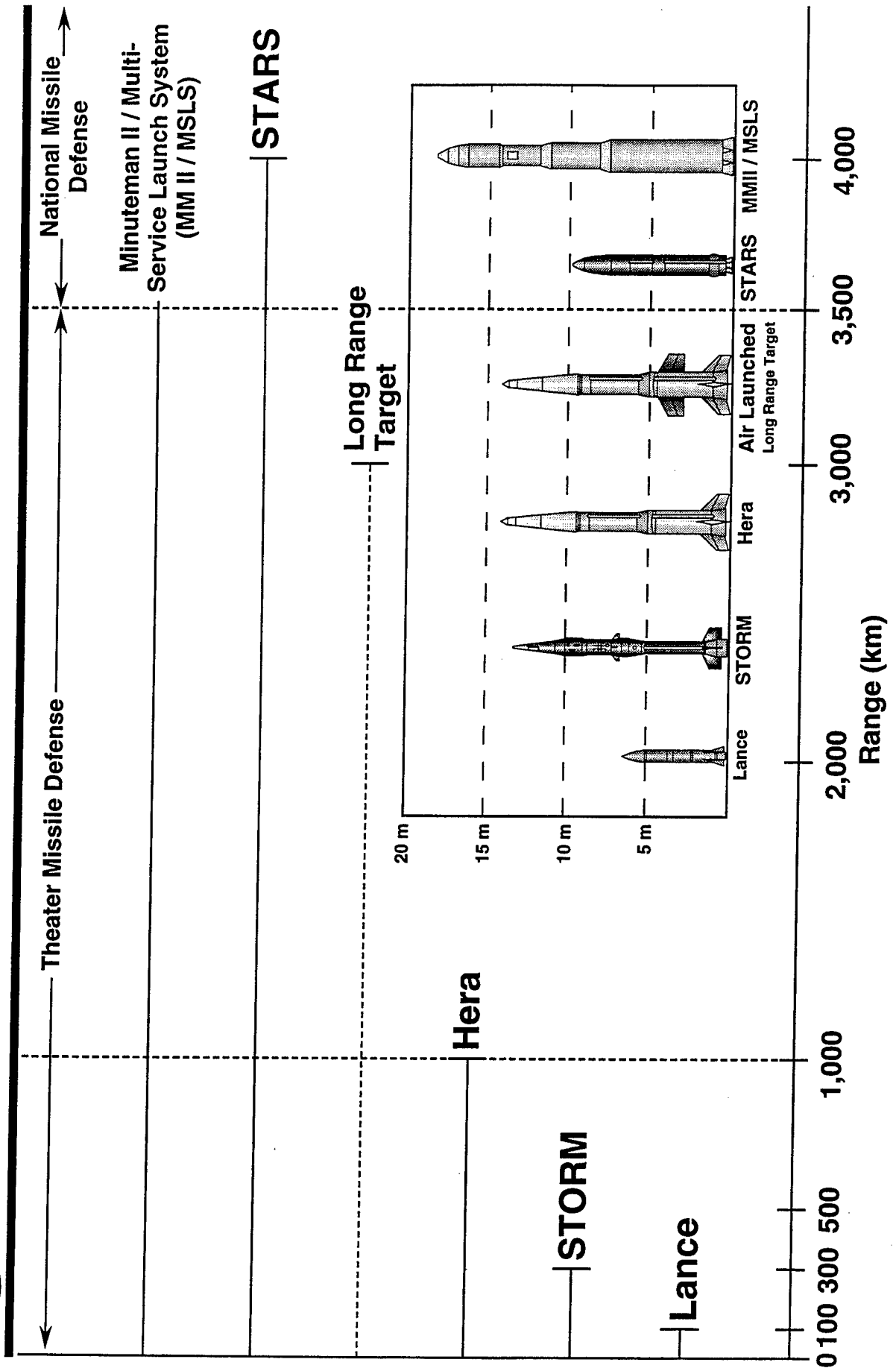


Huntsville, AL





# TARGET INVENTORY

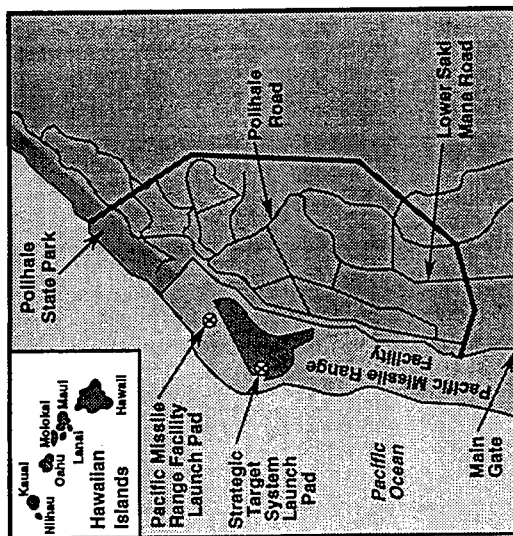




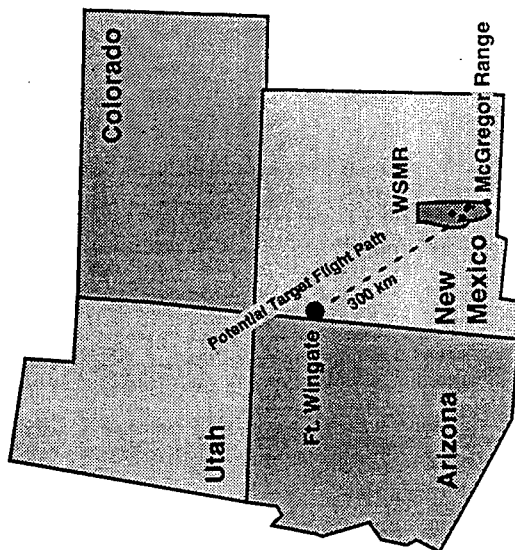


# TMD TEST RANGE ALTERNATIVES

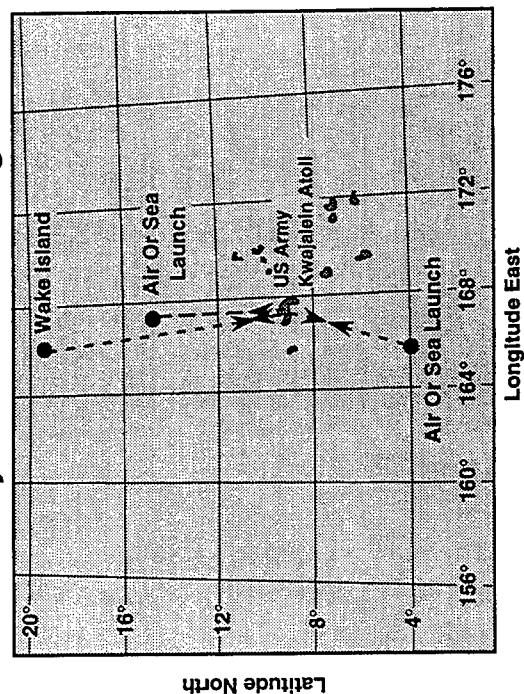
## PMRF



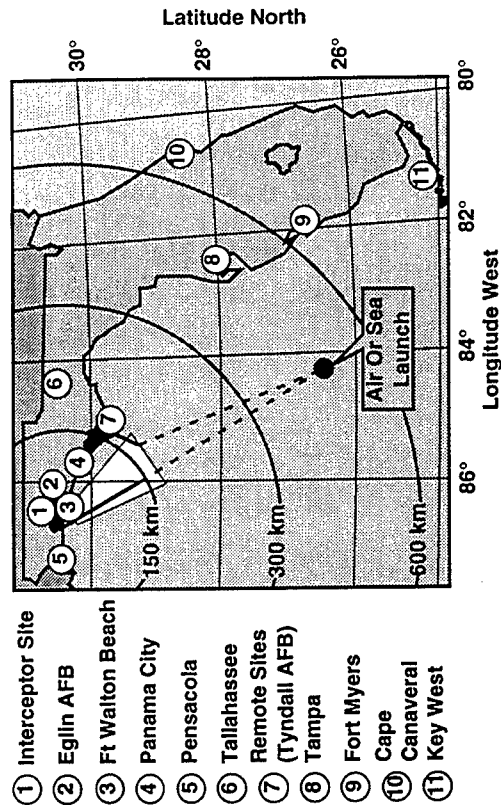
## WSMR



## Kwajalein Missile Range



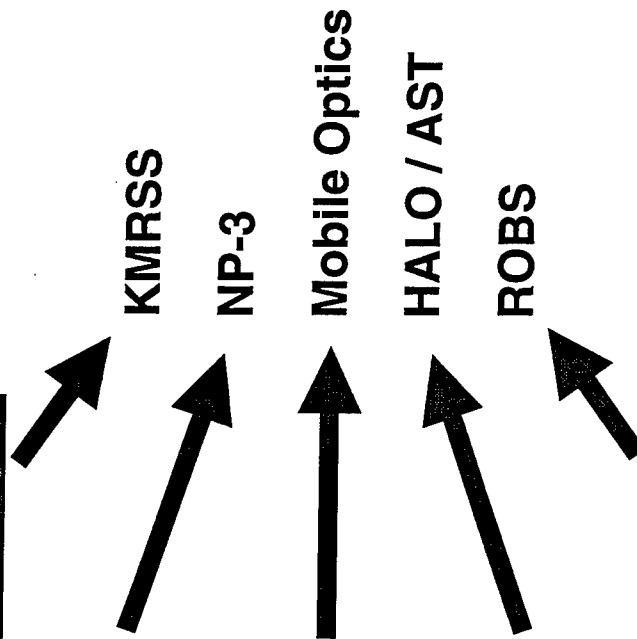
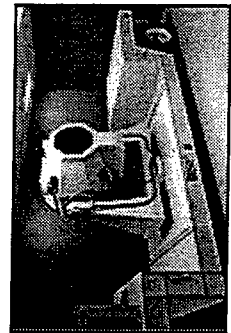
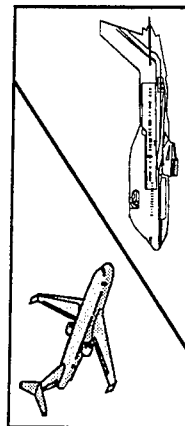
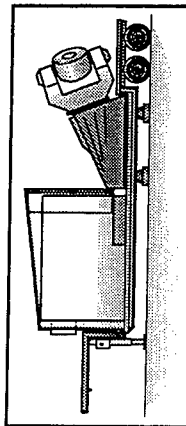
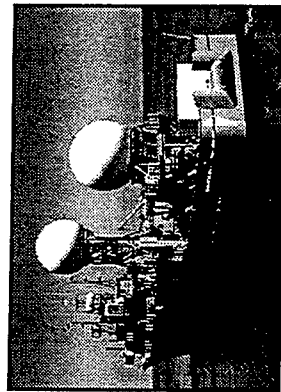
## Eglin Air Force Base







# INSTRUMENTATION ASSETS



- Mobile Radar
- Precision TSPI
- TRACS
- Mobile Range





# **FACILITIES, SITING AND ENVIRONMENT**

---

- **Reduce Cost Through Effective Siting Of Facilities**
- **Comply With Environmental Policy And Laws During Decision Making And In Program Activities**
- **Construct Only What Is Required**
  - **Operational Facilities (e.g., THAAD Battalion Facilities At Ft. Bliss, NMD Facilities)**
  - **Test Facilities (e.g., Target Launch Complexes At Ft. Wingate And Wake Island)**





# SUMMARY

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## *AQT Directorate Bottom Line*

- Ensure T&E Planning, Resources And Execution Are In Place For The Individual Acquisition Program And Family Of Systems Testing
- Ensure Facility Construction And Environmental Compliance Of BMDO Programs



# BACKUP





## CIVIL ENGINEERING AND ENVIRONMENTAL INITIATIVES AND OPPORTUNITIES

### *Current*

Description	Award Date	Value (\$ In M)
• TMD Target Launch Complex (Wake Island)	SEP 94	7.97
• TMD Target Launch Facilities (FT. Wingate, NM)	SEP 95	4.60
• THAAD Radar Characterization Site Upgrade (Kwajalein)	MAR 96	0.15
• PAC-3 Missile Assembly Building (White Sands, NM)	FEB 96	1.40
• THAAD Launch Shelters (White Sands, NM)	MAR 96	1.60

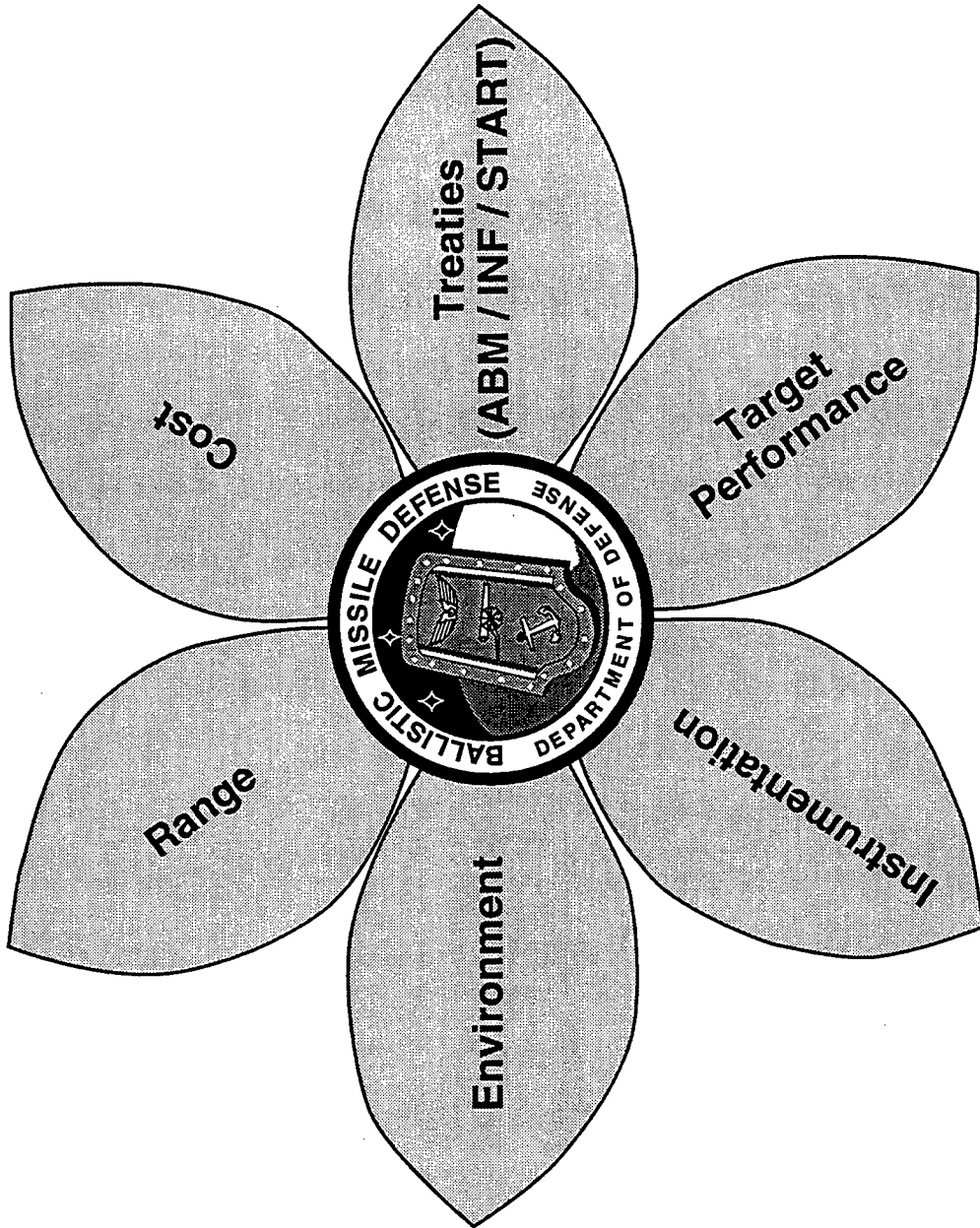
### *Planned*

• THAAD First Battalion Facilities (Ft. Bliss, TX)	JUN 96	11.00
• Ground Based Radar Prototype (Kwajalein)	JUN 96	11.00
• TMD Test Facilities (Kwajalein)	JUN 97	4.60





# TEST AND EVALUATION CONUNDRUM



**The Challenge: Find The Feasible Solution**



# Test And Evaluation Review



April 1996

**COL Andrew J. Fallon, USA**  
**Director, Test And Evaluation**  
**Acquisition / Theater Missile Defense Deputate**  
**Ballistic Missile Defense Organization**



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# PEO Missile Defense Army Perspective On Missile Defense

Presented By:

COL (P) Daniel Montgomery  
PEO Missile Defense

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## MISSION

The Program Executive Office For Missile  
Defense Develops, Integrates, Acquires,  
And Fields Quality Air And Missile  
Defense Systems

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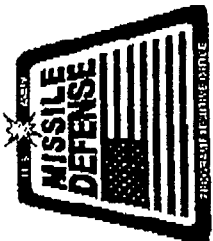
SLIDE # 1

MISSION

THE PROGRAM EXECUTIVE OFFICE FOR MISSILE DEFENSE DEVELOPS, INTEGRATES,  
ACQUIRES, AND FIELDS QUALITY AIR AND MISSILE DEFENSE SYSTEMS.



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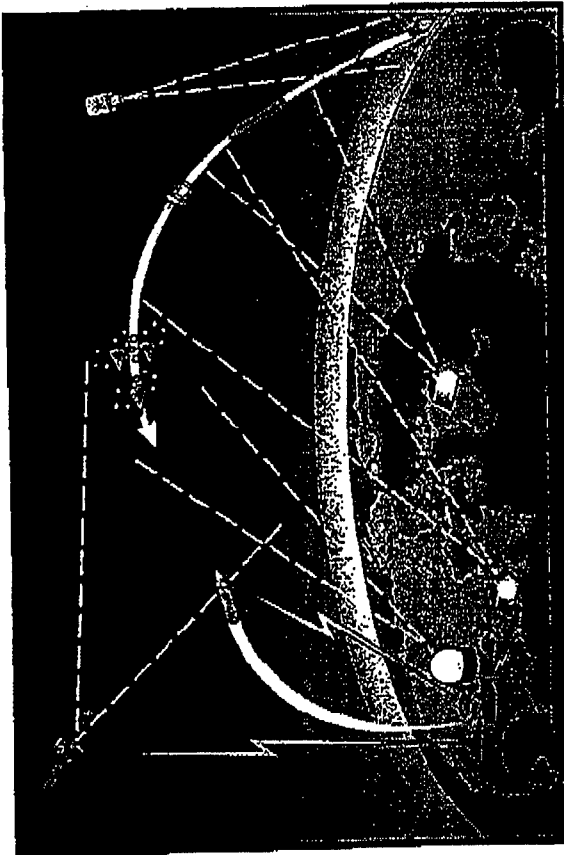


# ARMY MISSILE DEFENSE STRATEGY



## Theater Missile Defense

- Effective
- Deployable
- Mobile
- Interoperable



## National Missile Defense

- Effective
- Affordable
- Treaty Compliant

*Protecting The Force . . .*

*. . . And The NATION*

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SLIDE # 2

ARMY MISSILE DEFENSE STRATEGY

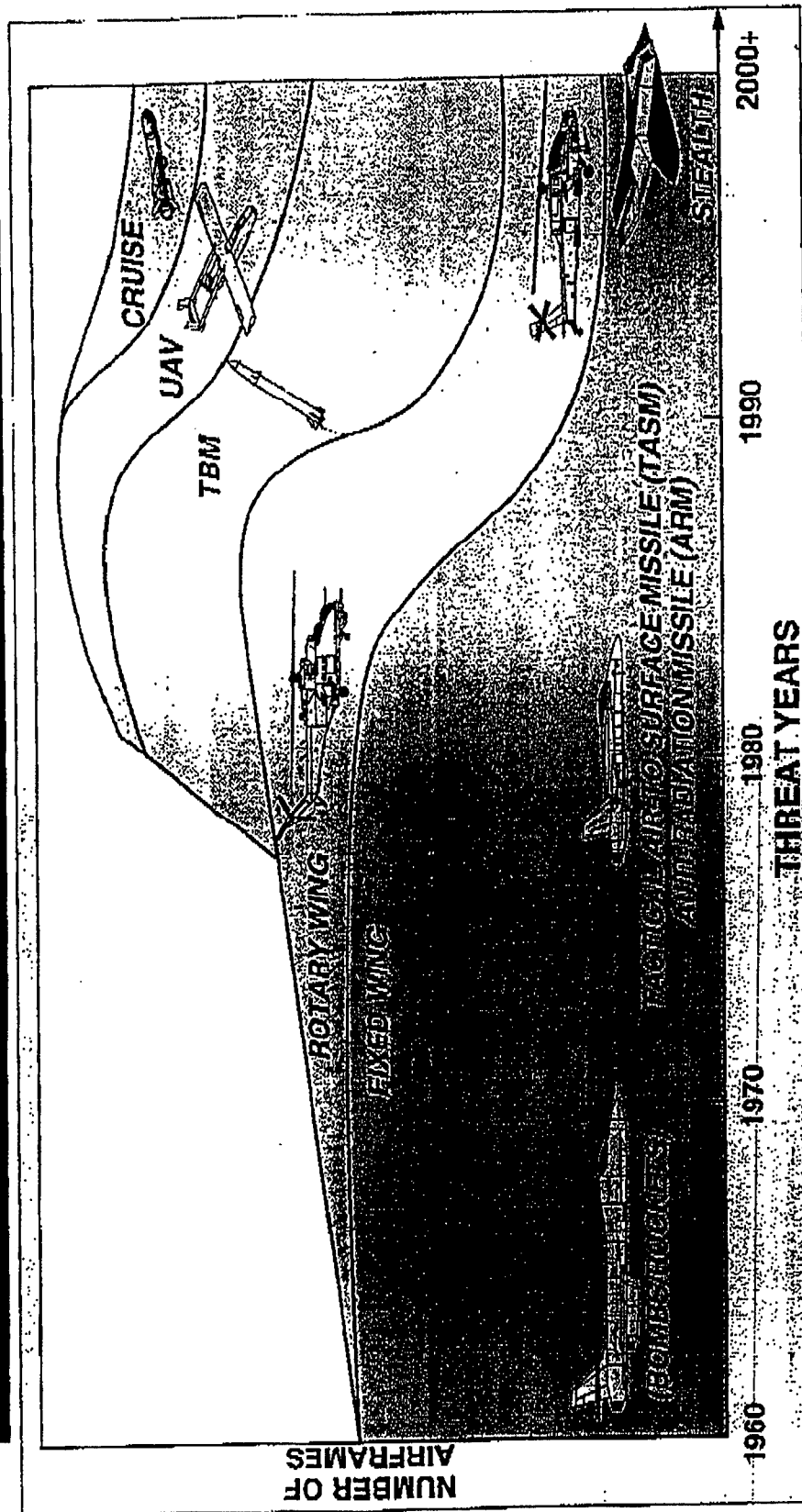
THE ARMY'S MISSILE DEFENSE STRATEGY CONSISTS OF DEVELOPING AN EFFECTIVE,  
DEPLOYABLE, AND INTEROPERABLE THEATER MISSILE DEFENSE SYSTEM TO PROTECT FORCE XXI...  
AND AN EFFECTIVE, AFFORDABLE AND TREATY COMPLIANT NATIONAL MISSILE DEFENSE SYSTEM TO  
PROTECT THE NATION.





# AIR AND MISSILE THREAT EVOLUTION

**TACTICAL MISSILES AND UNMANNED AERIAL VEHICLES  
A WHOLE NEW PROBLEM FROM COLD WAR EUROPE**



- REDUCED RELIANCE ON MANNED AIRCRAFT
- INCREASING TBM, UAV, CM THREAT
- HIGH TECHNOLOGY APPLIED WORLDWIDE



**SLIDE # 3**

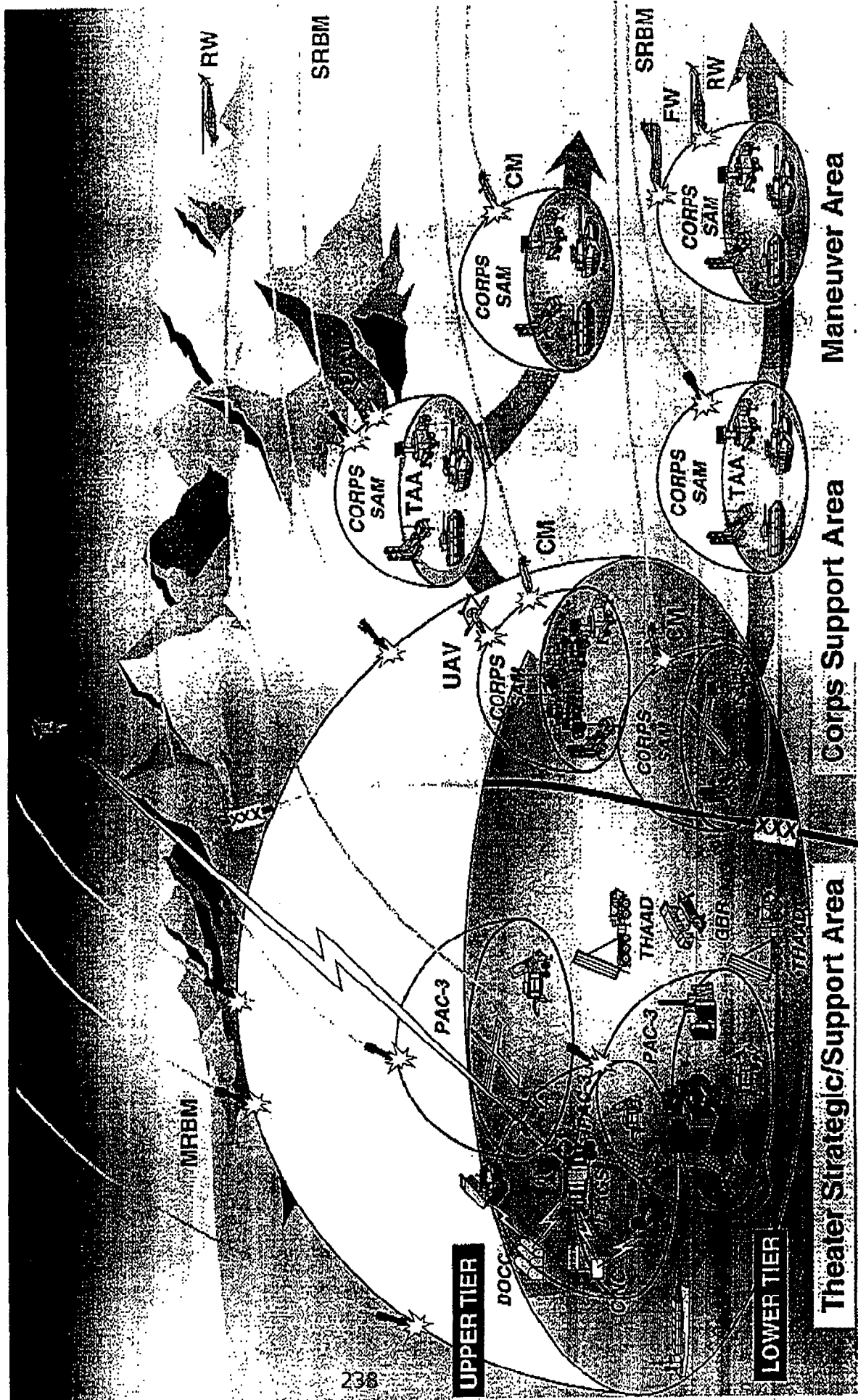
**AIR AND MISSILE DEFENSE THREAT EVOLUTION**

DURING THE COLD WAR, THE THREAT EMPHASIS WAS ON LARGE MASS FORMATIONS OF FIXED WING AIRCRAFT ARMED WITH BOMBS AND ROCKETS. WHILE THE FIXED WING THREAT HAS CONTINUED TO EVOLVE QUALITATIVELY TO THE CURRENT ERA OF REDUCED SIGNATURE AIRCRAFT, THE EMPHASIS HAS SHIFTED TO THE USE OF TACTICAL BALLISTIC MISSILES, UNMANNED AERIAL VEHICLES, AND CRUISE MISSILES.



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# ARMY THEATER MISSILE DEFENSE OBJECTIVE



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## SLIDE # 4

### ARMY THEATER MISSILE DEFENSE OBJECTIVE

OVER THE NEXT DECADE, INTO THE 21ST CENTURY, THE ARMY WILL DEPLOY AN INTEGRATED AIR AND MISSILE DEFENSE CAPABILITY CAPABLE OF DEFEATING THE ENTIRE AIR AND MISSILE THREAT SPECTRUM.

PAC-3 WILL REPLACE THE CURRENT PAC-2 SYSTEM. THIS WILL PROVIDE INCREASED CAPABILITY AGAINST SRBM, SOME MRBM, AND CRUISE MISSILE THREATS AND PROVIDE A LOWER TIER CAPABILITY TO AUGMENT THE UPPER TIER SYSTEM.

THE UPPER TIER THEATER HIGH ALTITUDE AREA DEFENSE (THAAD) SYSTEM WILL PROVIDE LONG RANGE, HIGH ALTITUDE INTERCEPT OF MRBM AND SOME SRBM TARGETS. THE THAAD SYSTEM WILL BE THE ONLY EXO AND ENDO-ATMOSPHERIC INTERCEPTOR SYSTEM IN THE WORLD WHEN FIELDIED.

WHILE THE UPPER AND LOWER TIER AIR AND MISSILE DEFENSE TASK FORCE WILL PROVIDE NEAR LEAK PROOF PROTECTION FOR CINC DESIGNATED CRITICAL ASSETS, THE MANEUVER FORCE IS STILL WITHOUT ADEQUATE MISSILE PROTECTION UNTIL THE FIELDING OF THE CORPS SURFACE-TO-AIR MISSILE (CORPS SAM). THE CORPS SAM SYSTEM, ALSO KNOWN AS MEDIUM EXTENDED AIR DEFENSE SYSTEM (MEADS), IS A MULTINATIONAL DEVELOPMENT SYSTEM THAT WILL BE DEPLOYED WITH MANEUVER FORCES TO PROVIDE PROTECTION FROM MISSILE AND AIR BREATHING THREATS. CORPS SAM WILL ALSO PROVIDE LOWER TIER PROTECTION TO AUGMENT PATRIOT WHEN NECESSARY.







COMPLETING THE OBJECTIVE THEATER MISSILE DEFENSE SYSTEM WILL BE THE JOINT TACTICAL GROUND STATION (JTGS). JTGS WILL PROCESS SENSOR DATA FROM DEFENSE SUPPORT PROGRAM SATELLITES AND PASS THAT DATA TO THE THEATER TO CUE ACTIVE DEFENSE SYSTEMS, WARN THE THEATER TO TAKE PASSIVE DEFENSE MEASURES, AND ALERT ATTACK OPERATIONS SYSTEMS AS TO THE LOCATION OF MISSILE LAUNCHERS.

I WILL EXPLAIN THE WORKINGS OF THE AIR AND MISSILE DEFENSE TASK FORCE IN A LATER SEQUENCE.





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# PATRIOT (PAC-3)

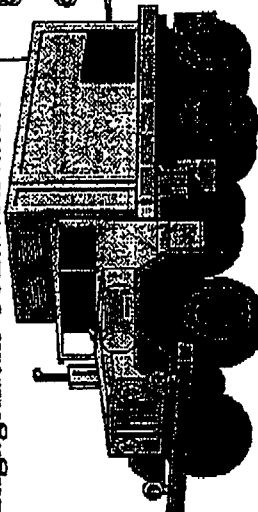
## PAC-3 Missile

- ERINT Integration
- Improved Lethality
- Expanded Engagement Envelope
- Active Seeker

- Better Computer
- Improved Processing
- Communications With ICC
- Imbedded Data Recording

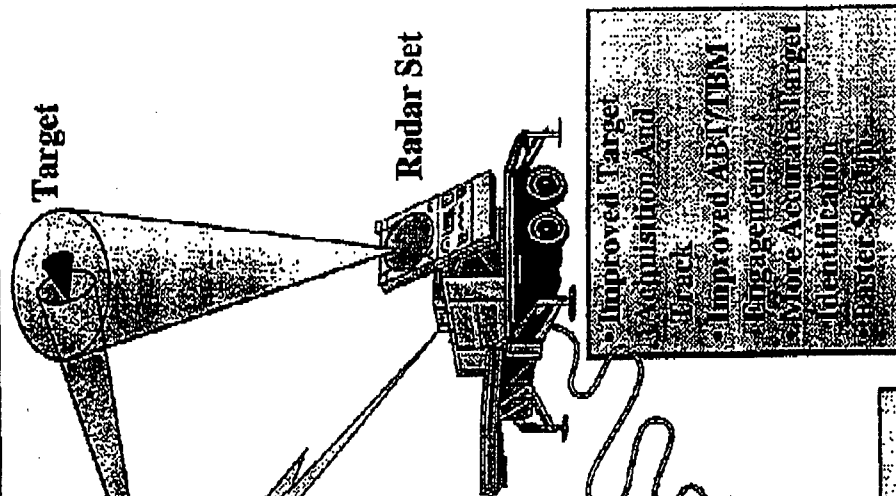
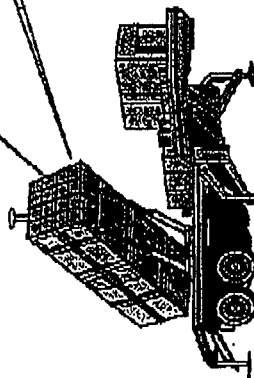
## PATRIOT

## Engagement Control Station



- Faster Set Up
- Remote Launch
- Improved Electronics

## PAC-3 Missile Launching Station



- Improved Target Acquisition and Track
- Improved ABM/TBM Engagement
- More Accurate Target Identification
- Faster Set Up

## On The Battlefield In 1999

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SLIDE # 5

PATRIOT (PAC-3)

THE PAC-3 SYSTEM CONSISTS OF FOUR MAJOR COMPONENTS:

- A RADAR SET THAT ACQUIRES AND TRACKS THE TARGET, AND GUIDES THE MISSILE TO THE VICINITY OF THE TARGET.

- A LAUNCH STATION TO FIRE THE INTERCEPTOR.

- THE PAC-3 MISSILE WHICH PROVIDES HIGH ENERGY IMPACT KILLS TO ENSURE LETHALITY.

- AND THE ENGAGEMENT CONTROL STATION WHICH NOT ONLY PROVIDES FIRE CONTROL FOR THE PAC-3, BUT ALSO THE PAC-2 MISSILES WHICH WILL CONTINUE TO BE A PART OF THE PATRIOT SYSTEM.



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# THEATER HIGH ALTITUDE AREA DEFENSE (THAAD) SYSTEM

- 6 Month Extension to SSC Approved Baseline Program Schedule
- Builds On UOES Design

*Provides Minimum, Low Risk Enhancements*



*Launcher / Missile*

- Current Booster
- Liquid DAGE
- InSb Seeker



*Radar*

- Processor Upgrades
- RF/Range Modules With
- PRF Variable Technology
- Power Amplifier
- Receiver Channel



*BM/C3I*

- CHS-2 Computer
- Integrated SW
- Homogeneity

THAAD SCHEDULE TO 1991  
Full Deployment Beginning 2001

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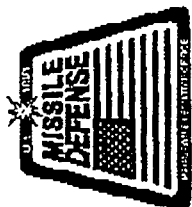
**SLIDE # 6**

**THEATER HIGH ALTITUDE AREA DEFENSE (THAAD)**

**THE THAAD SYSTEM CONSISTS OF THE**

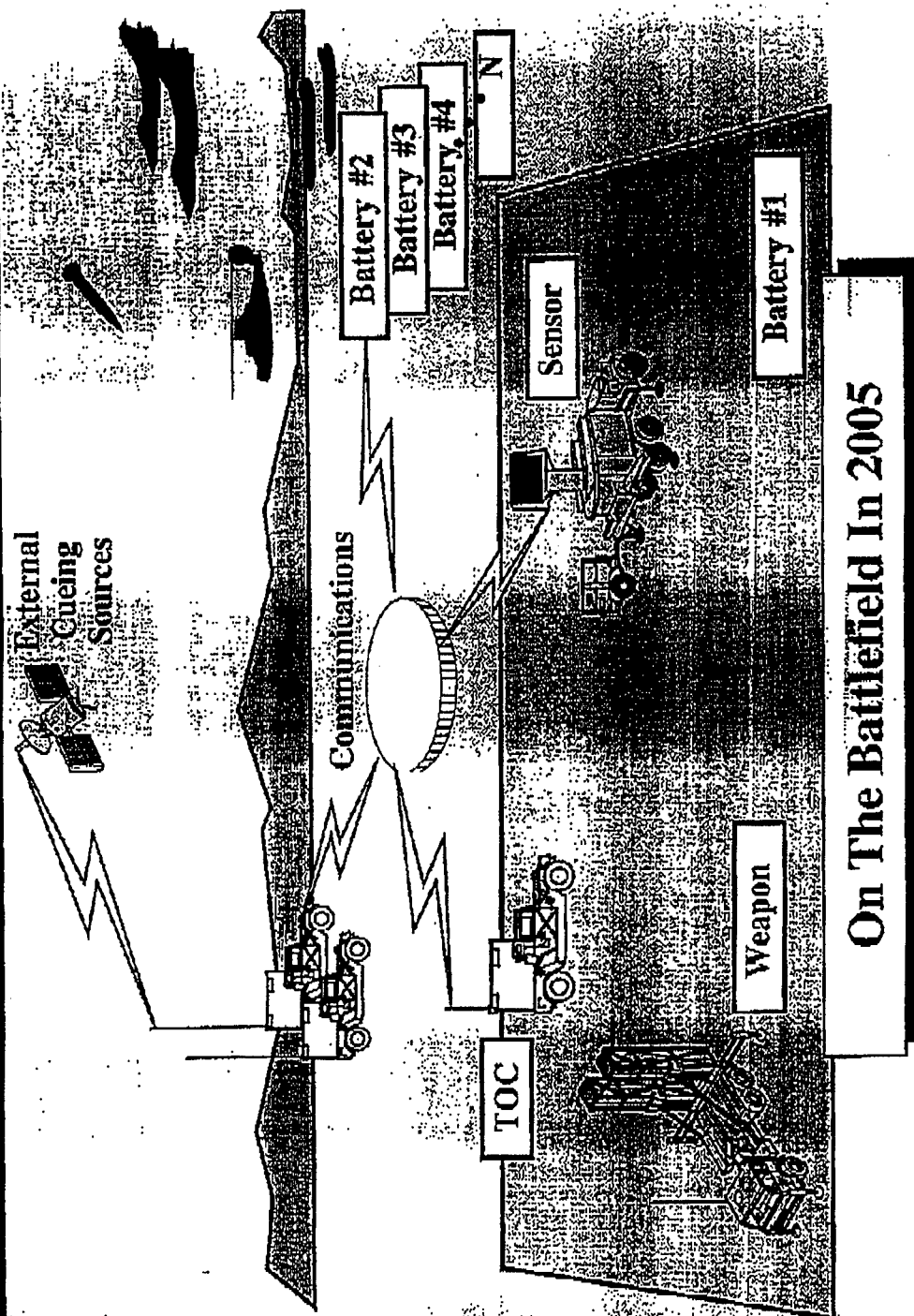
- **GROUND BASED RADAR.**
- **PALLETIZED LOADING SYSTEM (PLS) LAUNCHER.**
- **MISSILE AND KILL VEHICLE.**
- **AND THE BM/C3I ELEMENT**





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## CORPS SAM / MEADS



On The Battlefield In 2005

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**SLIDE # 7**

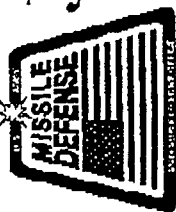
**CORPS SAM/MEADS**

**THE CORPS SAM MEADS SYSTEM WILL CONSIST OF THE**

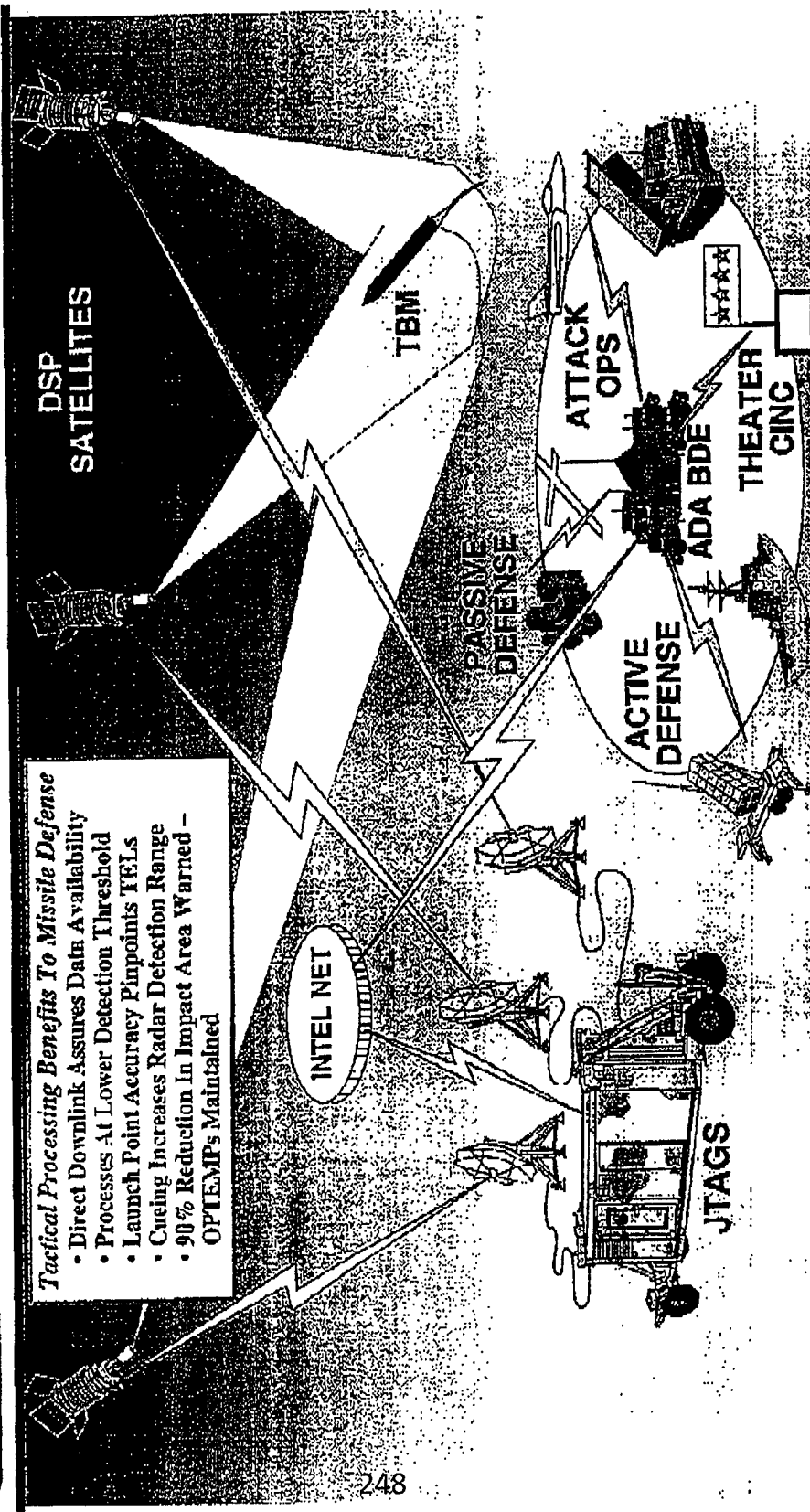
- SENSOR.**
- LAUNCHER AND KILL VEHICLE**
- TACTICAL OPERATIONS CENTER (TOC).**
- ASSOCIATED COMMUNICATIONS.**
- AND EXTERNAL CUEING SOURCES**



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# JOINT TACTICAL GROUND STATION (JTAGS)



On The Battlefield In 1997

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**SLIDE # 8**

**JOINT TACTICAL GROUND STATION (JTGS)**

**THE JTGS SYSTEM CONSISTS OF THE**

- RECEIVING ANTENNAE.**
- JTGS SHELTER WITH ASSOCIATED COMPUTER HARDWARE AND SOFTWARE AND CONTROL**

**STATIONS.**

**AS DESCRIBED EARLIER, JTGS RECEIVES DATA FROM DSP SATELLITES, PROCESSES THAT DATA AND PASSES TO THE THEATER CINC, ADA BDE, ACTIVE DEFENSE, PASSIVE DEFENSE, ATTACK OPERATIONS, AND OTHER JOINT ELEMENTS.**



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# INTERCEPTOR LETHALITY

## Problem

- Wide Spectrum Of Stressing Threats
- Chemical & Biological Submunitions Are Hard To Kill
- Partial Dismemberment Not Acceptable For Critical Defended Areas
  - Large Population Centers
  - APOD / SPODs
  - C2 Centers

250

## Solution

- Develop Interceptors Capable Of Total Target Destruction
  - High Mass / Velocity
  - Maximum Energy Transfer
- Requires Small Miss Distances
  - Seekers
  - Control Systems
  - Aimpoint Selection Algorithms
- Validated By Simulations, Sled / LGG Tests, And Flight Tests

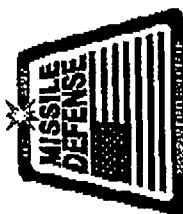
High Energy Impact Provides Overmatching Lethality For Hard Kill Of All Threats

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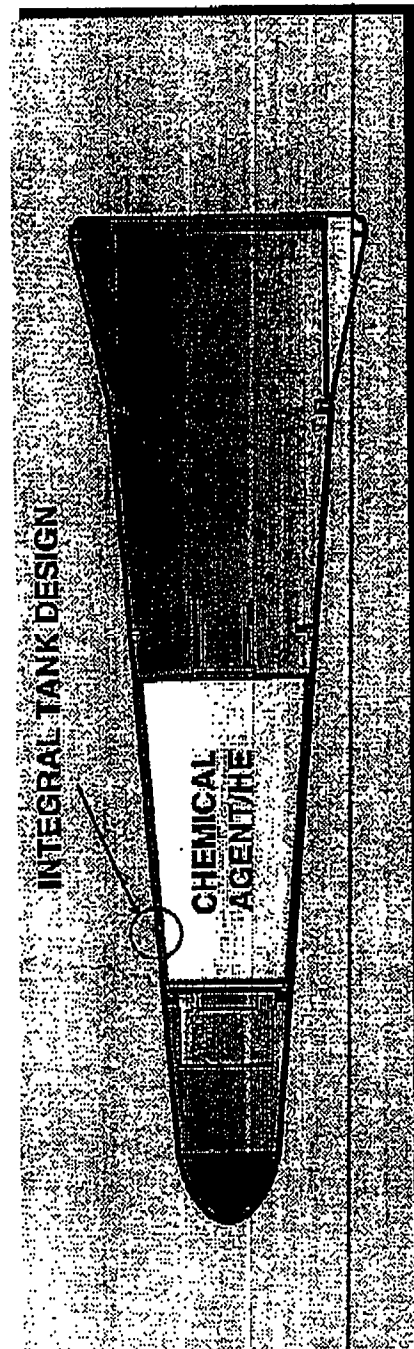
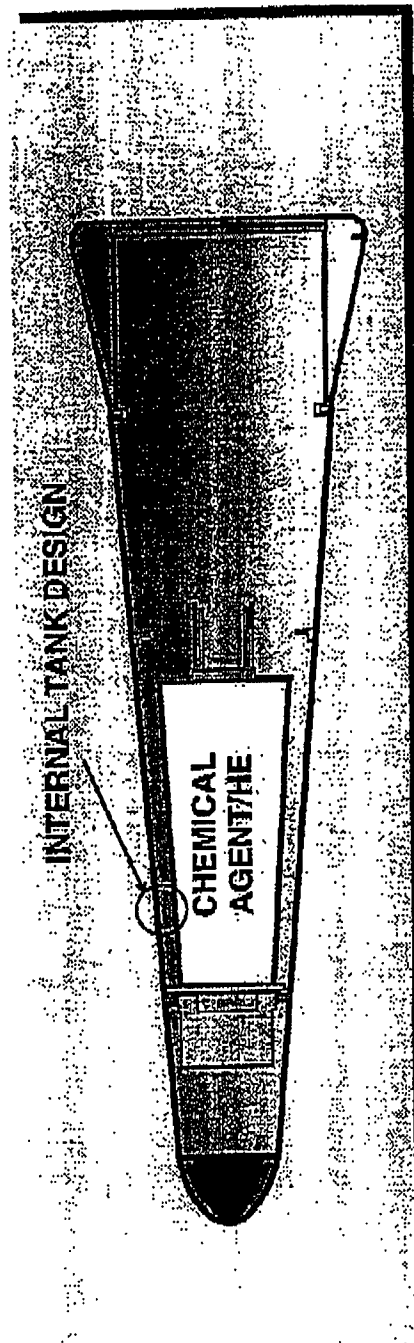
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## TYPICAL UNITARY WARHEAD



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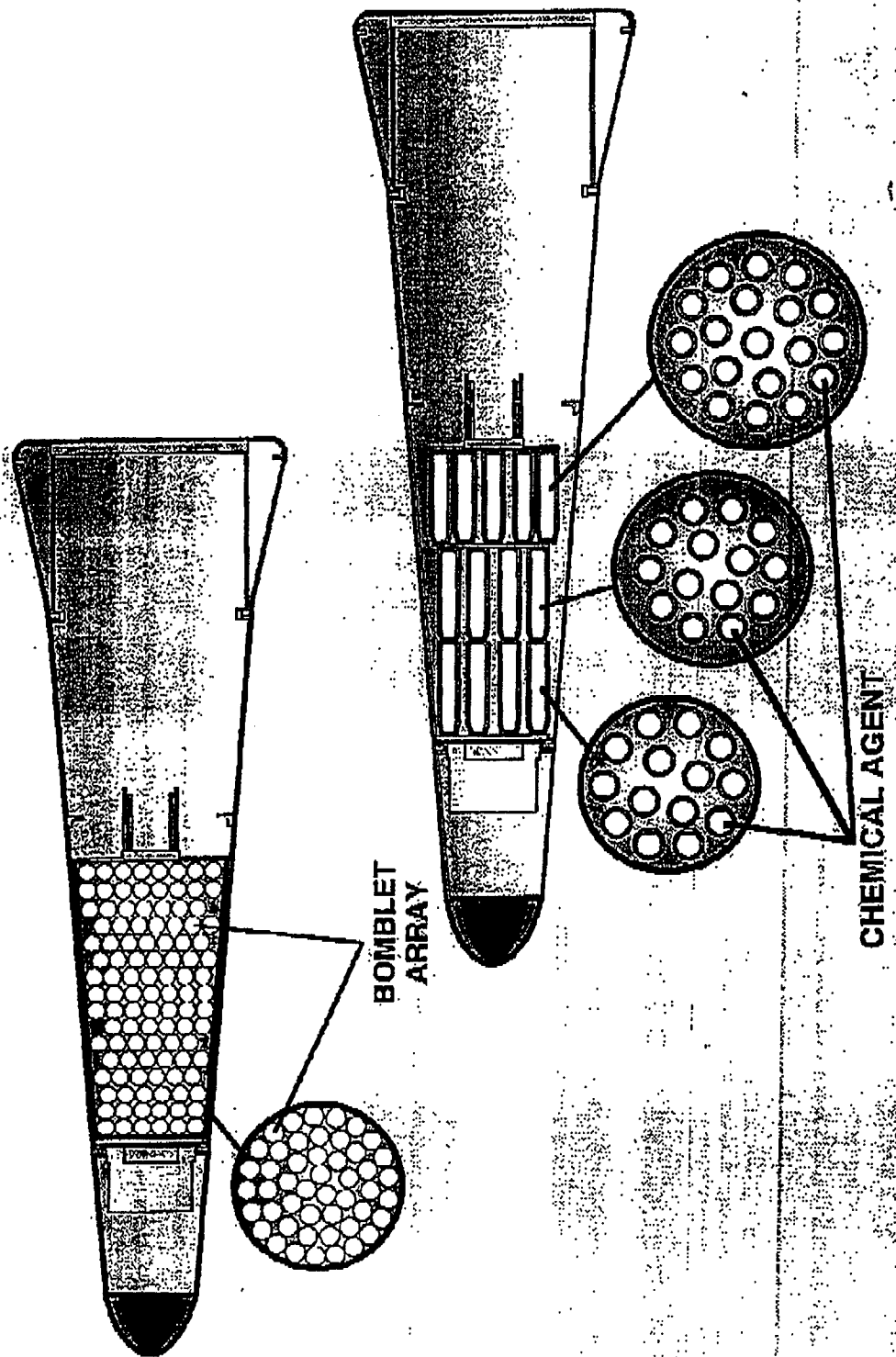
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## TYPICAL SUBMUNITION PAYLOADS



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SLIDE # 9

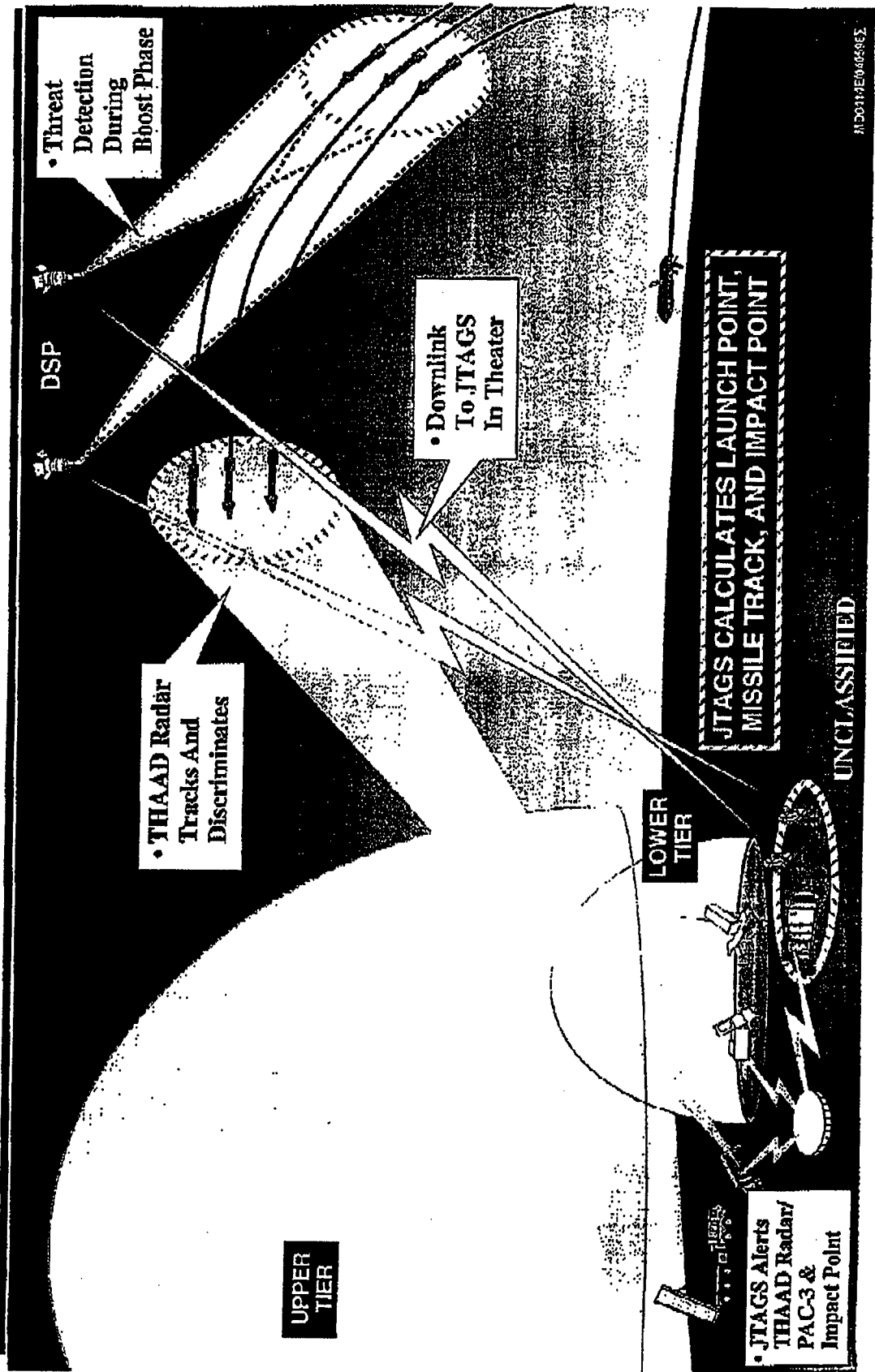
INTERCEPTOR LETHALITY

- THE PROBLEM: A TMD UNIT MUST DEFEND AGAINST A VARIETY OF THREAT MUNITIONS CARRIED ON AN ASSORTMENT OF CARRIER SYSTEMS. THESE INCLUDE UNITARY, BULK OR SUBMUNITION WARHEADS CARRYING CONVENTIONAL, CHEMICAL, BIOLOGICAL, OR NUCLEAR PAYLOADS. THE MOST CHALLENGING ARE THOSE CARRYING SUBMUNITIONS. THE MOST EFFECTIVE DEFENSE AGAINST THIS THREAT IS TO DESTROY OR OPEN EACH SUBMUNITION. WHEN IN AN AREA DEFENSE PROTECTING CRITICAL MILITARY OR GEOPOLITICAL TARGETS WITH HIGH CONCENTRATIONS OF PERSONNEL, A MISSION KILL BY PREVENTING THE THREAT FROM HITTING ITS TARGET IS NOT GOOD ENOUGH.
- THE SOLUTION: DESTRUCTION OF THESE TARGETS CAN BE ACHIEVED BY MORE MASSIVE, FASTER, INTERCEPTORS OR INTECEPTORS DESIGNED WITH OPTIMUM GEOMETRY AND MASS DISTRIBUTION TO MAXIMIZE THEIR LETHAL CAPABILITY. THE COST OF THESE ENHANCEMENTS MUST BE TRADED AGAINST THE COST OF DEVELOPING MORE ACCURATE SEEKERS, BETTER CONTROL SYSTEMS, AND MORE PRECISE AIM POINT SELECTION ALGORITHMS.
- CONCLUSION: BASED UPON SIMULATIONS, ANALYSIS, AND TESTING THE ARMY HAS SELECTED HIGH ENERGY IMPACT AS THE PREFERRED METHOD FOR PROVIDING OVERMATCHING LETHALITY TO NEGATE THE EFFECTIVENESS OF TBM THREATS.



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# TWO TIER DEFENSE DETECTION AND TRACKING



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SLIDE # 10

TWO TIER DEFENSE DETECTION AND TRACKING

THE NEXT SEQUENCE ILLUSTRATES A TYPICAL TWO TIER DEFENSE SCENARIO.

- AS THE TBMs ARE LAUNCHED THEY ARE DETECTED BY THE DSP SATELLITES.
- THIS INFORMATION IS TRANSMITTED TO THE JTAGS WHICH THEN PROCESSES TO CALCULATE LAUNCH POINT, MISSILE TRACK, AND PROJECTED IMPACT POINT.
- THIS INFORMATION IS PASSED TO THE ELEMENTS SHOWN EARLIER BUT FOR THIS ILLUSTRATION THE IMPORTANT RECIPIENTS ARE THE UPPER AND LOWER TIER SENSORS.
- NOTICE, ALSO, THAT AN INCOMING CRUISE MISSILE COMPLICATES THE PROCESS.





**SIGMATECH, INC.**

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Upstairs Fax: (205) 830-1376

## TELECOPIER LEAD SHEET

Date: 6 April 96

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From: Ken Grant

Ext: 208

Deliver To: Ms Karla Smith Jackson

Phone: \_\_\_\_\_

Company: BMD O

Fax: <sup>(703)</sup> 614-9064

**Message:**

Ms Jackson, the enclosed slides and facing page text is the most current draft of Col(P) Montgomery's presentation for 10 April 96. As you are aware, he will be giving an animated briefing, so there could be modifications at the last minute.

I sincerely appreciate your patience and assistance. I will call you on 8 April to confirm all of the particulars for Col(P) Montgomery's presentation.

Ken Grant

1st Try = 13 Charts

2d Try = 11 Charts

part  
II

Confirmation Of Transmission:

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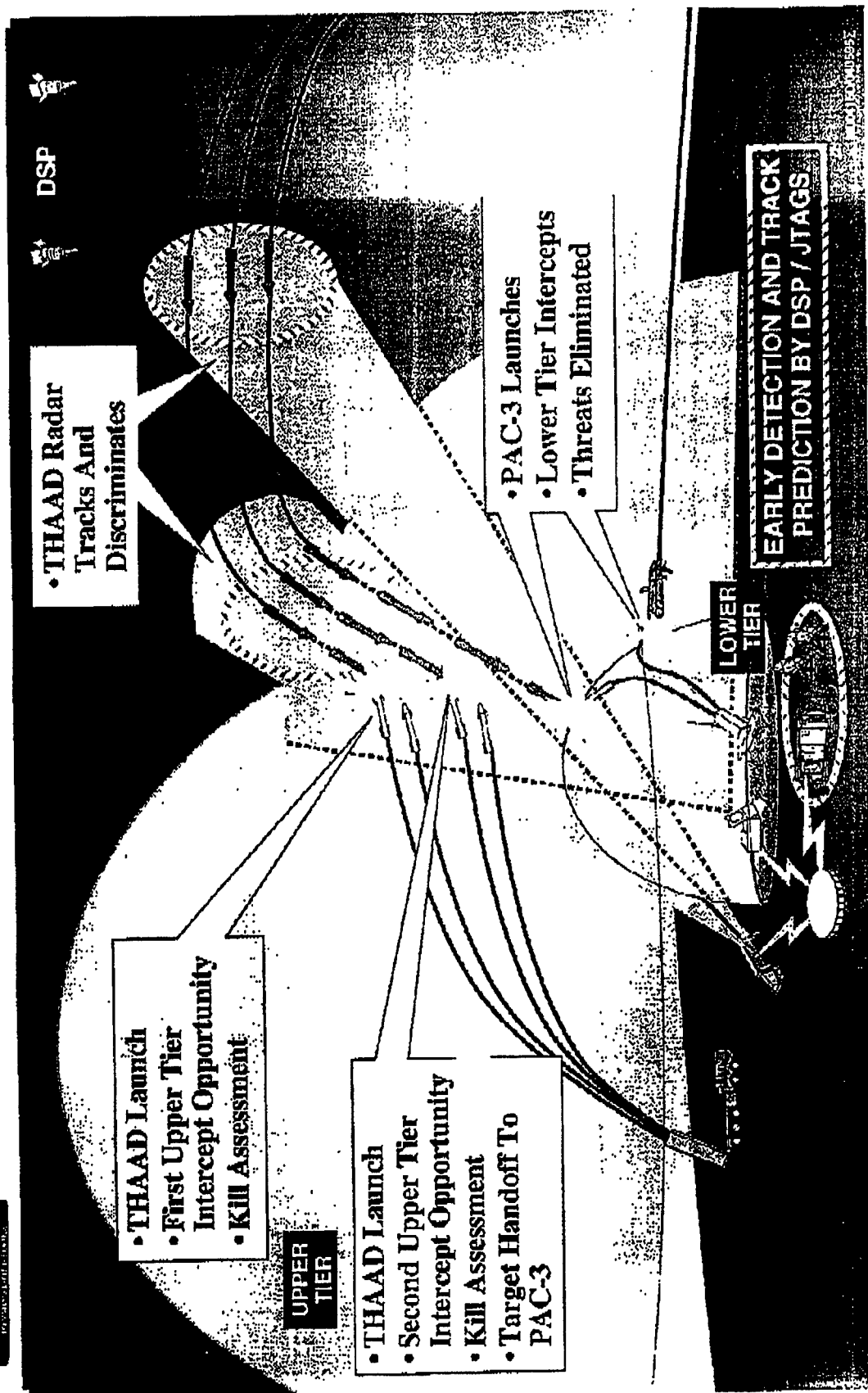
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## TWO TIER DEFENSE ENGAGEMENT SCENARIO





SLIDE # 11

TWO TIER ENGAGEMENT SCENARIO

AS THE TARGETS CONTINUE TO INGRESS THE FOLLOWING SEQUENCE OCCURS

- AS THE TBMs ENTER THE RANGE FOR THE THAAD GBR, THAT SENSOR ACQUIRES, TRACKS, AND DISCRIMINATES THE TARGETS.

- THAAD LAUNCHES ITS FIRST INTERCEPTOR AT THE GREATEST RANGE POSSIBLE, USUALLY EXOATMOSPHERIC.

- A KILL ASSESSMENT OCCURS AND THE DECISION FOR A SECOND INTERCEPT LAUNCH IS MADE.

- FOR PURPOSES OF ILLUSTRATION WE SHOW A HIT AND A NON-ENGAGEMENT OR MISS.

- THE UPPER TIER THEN HANDS OFF THE TARGET TO THE LOWER TIER SYSTEM WHICH ENGAGES THE FINAL TARGET.

- MEANWHILE, THE CRUISE MISSILE HAS BEEN DETECTED BY THE PAC-E RADAR AND SUBSEQUENTLY ENGAGED.

THIS IS CERTAINLY A SIMPLISTIC MODEL BECAUSE IT ASSUMES THE TARGET MISSILES ARE OF A CLASS THAT BOTH THAAD AND PAC-3 CAN ENGAGE. WHILE THIS MODEL DEPICTS THE GREATEST RANGE OF THREAT VEHICLES, THERE ARE THOSE THAT FALL BELOW THE CAPABILITY OF THAAD TO

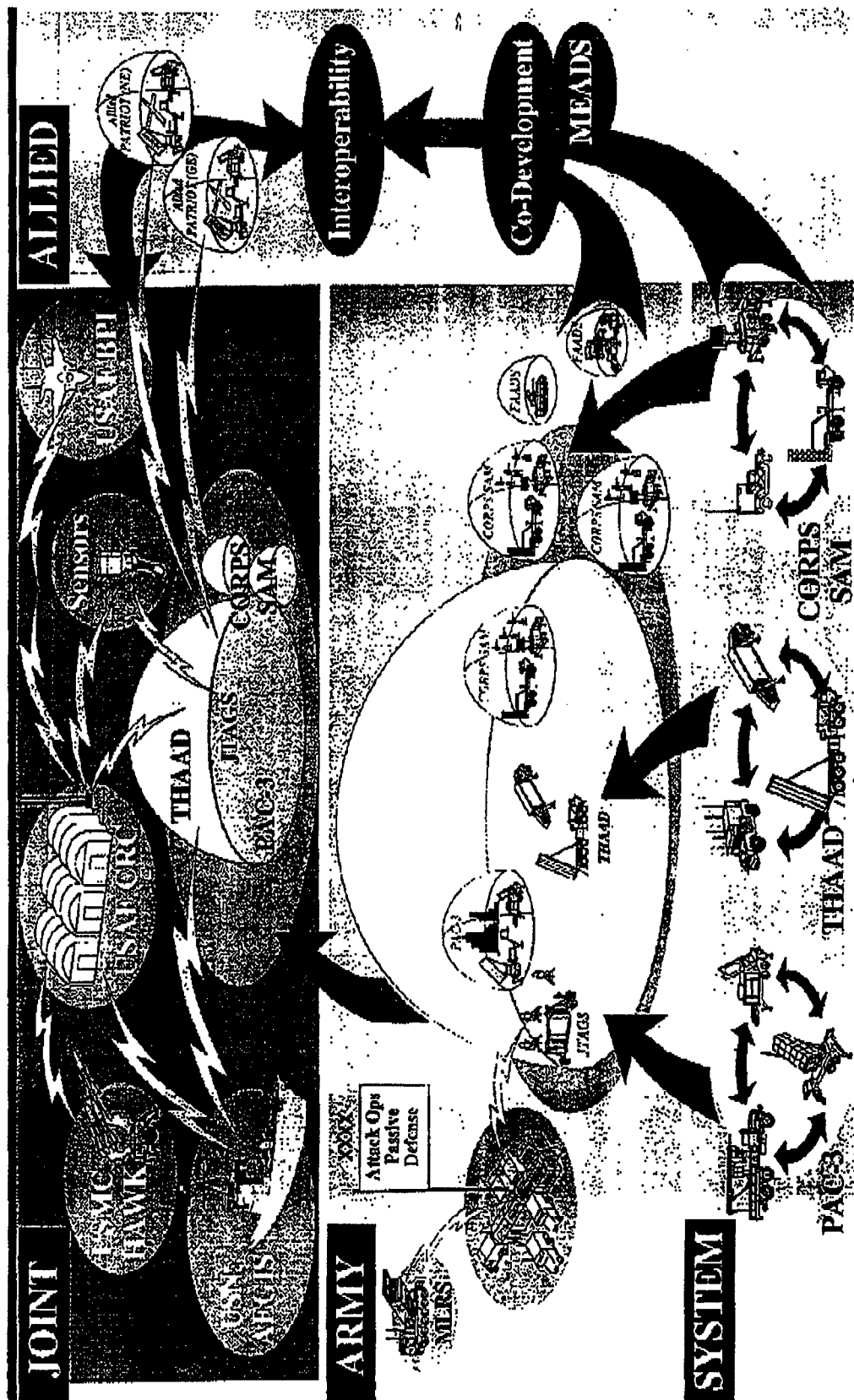


ENGAGE AND THAT FALL BEYOND THE PAC-3 CAPABILITY TO ENGAGE. THESE DISCRETE TARGETS  
MUST BE DEFEATED BY EITHER THE UPPER TIER OR LOWER TIER AS APPROPRIATE.



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# JOINT/ALLIED SYSTEMS INTEGRATION



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NO7130-0-1063



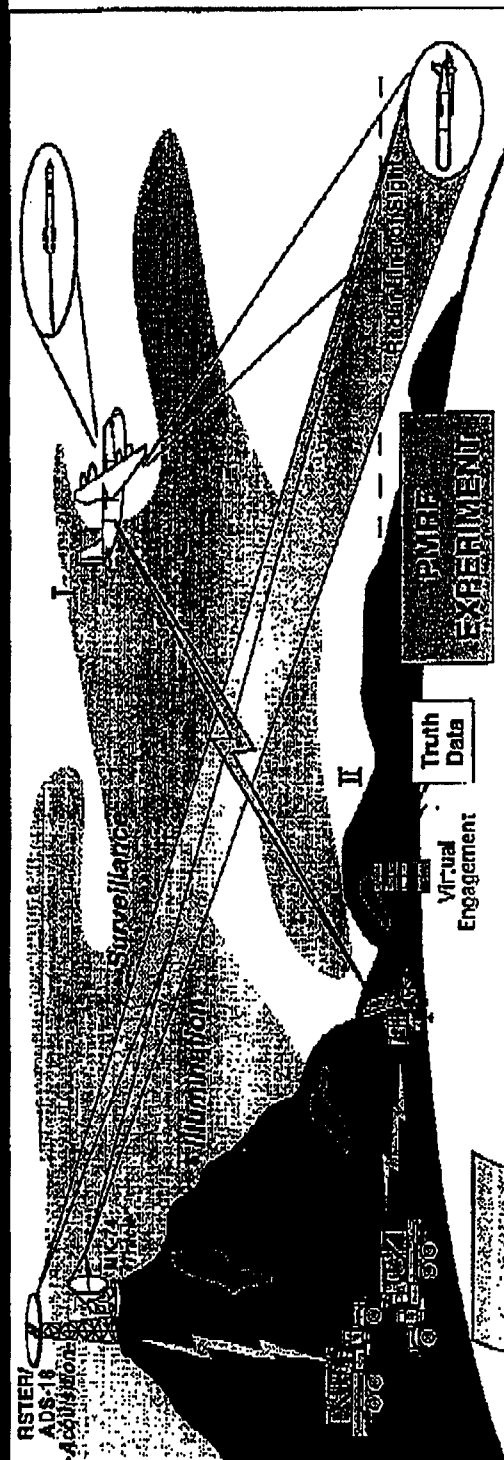
SLIDE # 12

JOINT/ALLIED SYSTEMS INTEGRATION

- AIR AND MISSILE DEFENSE PROGRAMS MUST INTEGRATE WITHIN THEIR SYSTEMS TO ENSURE SUBCOMPONENTS, COMPONENTS, AND SUBSYSTEMS ALL WORK SYNERGISTICALLY TOGETHER.
- AT THE PEO LEVEL, WE MUST ENSURE THAT AIR AND MISSILE DEFENSE SYSTEMS ARE INTEGRATED TO PROVIDE THE HIGHEST LEVEL OF AIR AND MISSILE DEFENSE TO THE ARMY AND TO ENSURE THE INTEGRATION OF ALL FOUR PILLARS OF THEATER MISSILE DEFENSE: ACTIVE DEFENSE, PASSIVE DEFENSE, ATTACK OPERATIONS, AND BM/C3I.
- AT THE JOINT LEVEL WE MUST ENSURE THAT WE ARE IN SYNCH WITH OUR SISTER SERVICES FOR COMMAND AND CONTROL AND TO ENSURE THE WIDEST PROTECTION FOR ALL FORCES.
- AND FINALLY WE MUST ENSURE THAT WE ARE INTEROPERABLE WITH OUR ALLIES AND ANY COALITION FORCES WE MAY HAVE TO DEPLOY WITH.

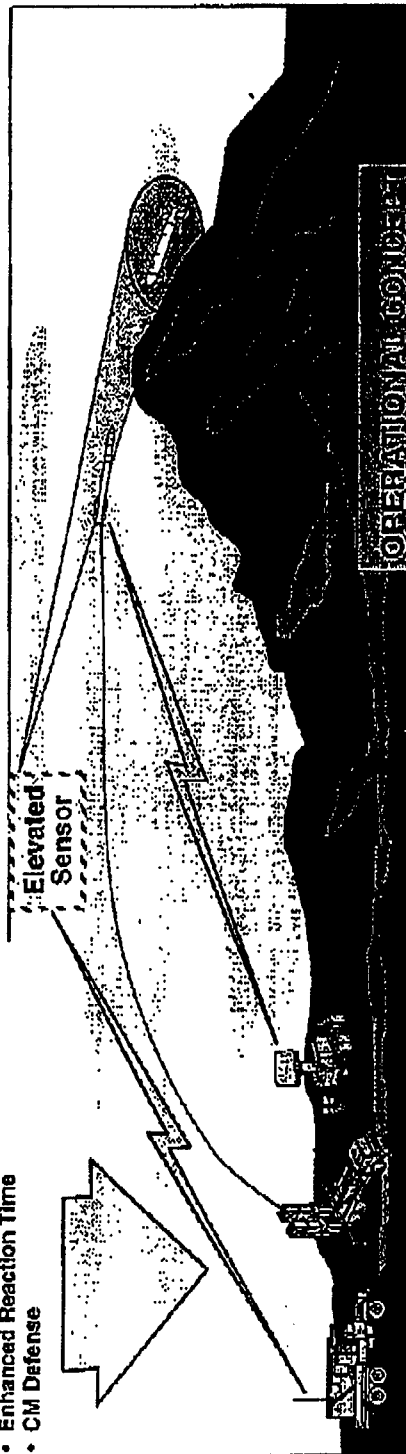


**ARMY MOUNTAIN TOP EXPERIMENT (AMTE)  
- VALUE TO U.S. ARMY PARTICIPATION -**



**PROOF OF PRINCIPLE**  
For

- Over-The-Horizon Engagement Capability (ADSAM)
- Enhanced Reaction Time
- CM Defense



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# CONFIRMATION OF CONFIDENTIALITY

558161H66WJF



SLIDE # 13

ARMY MOUNTAIN TOP EXPERIMENT (AMTE)

- VALUE TO U. S. ARMY PARTICIPATION

THE ARMY MOUNTAIN TOP EXPERIMENT (AMTE) WAS CONDUCTED IN COORDINATION WITH THE NAVY EXPERIMENT LAST JANUARY IN HAWAII. THE PURPOSE OF THE TEST WAS TO DEMONSTRATE THE CAPABILITY TO ENGAGE A CRUISE MISSILE BEYOND RADAR LINE OF SIGHT. IN THIS ILLUSTRATION THE RSTER/ADS-18 REPRESENTS AN ELEVATED ACQUISITION SENSOR. THIS SENSOR INITIALLY DETECTS THE LOW FLYING CRUISE MISSILE AND PASSES INFORMATION TO THE PATRIOT ENGAGEMENT STATION. THE MK-74 REPRESENTS AN ELEVATED TRACKING SENSOR WHICH PROVIDES TARGET UPDATE DATA AT A RATE THAT MAKES ENGAGEMENT POSSIBLE. THIS INFORMATION IS PASSED TO THE PATRIOT RADAR WHICH TRANSMITS TARGET LOCATION DATA TO A MISSILE SENSOR ON BOARD A CAPTIVE CARRY AIRCRAFT AND GUIDES THE SEEKER INTO AN ENGAGEMENT ENVELOPE THAT ALLOWS IT TO TRACK THE CRUISE MISSILE ON ITS OWN. THE PROCESS OCCURS WITHOUT ACTUALLY FIRING A MISSILE BY PROCESSING DATA FROM ALL SENSORS AND SEEKERS IN THE VIRTUAL ENGAGEMENT SYSTEM. THIS HIGHLY SUCCESSFUL EXPERIMENT ILLUSTRATES THE KEY INTERACTION AMONG SERVICES TO PROVIDE DEFENSE FOR OUR FORCES. THE BOTTOM PANEL SHOWS HOW THIS EXPERIMENT CAN CONTRIBUTE TO AN OPERATIONAL CONCEPT.

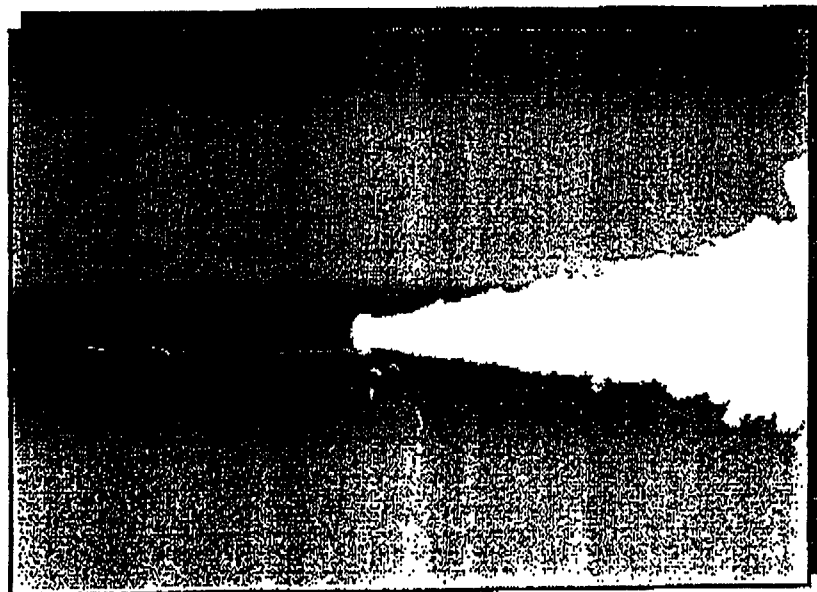




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## ARROW

- U.S.-Israeli Cooperative Development Program For A Theater Ballistic Missile Defense System
- Allows Israel Self-Protection Capability
- Cooperative Development For Missile/Launcher Only
- Deployability Program Will Definitize Fielding
- Reduces Risk And Schedule For THAAD And SM-2 Block IVA
  - Lessons Learned For High Speed Interceptor And Mass-Focused Warhead
  - Common/Similar Seeker Components
  - Shared Suppliers



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1 6 0 0 3 7 9 5 2



SLIDE # 14

ARROW

THE ARROW PROJECT IS A U. S. - ISRAELI COOPERATIVE DEVELOPMENT PROGRAM THAT WILL PROVIDE THE NATION OF ISRAEL A SELF-PROTECTION CAPABILITY AGAINST TBMs. THE U. S. IS COOPERATING IN THE DEVELOPMENT OF THE MISSILE AND LAUCHER ONLY. KEY BENEFITS FOR THE U.S. INCLUDE REDUCED RISK FOR THE THAAD AND STANDARD MISSILE 2 BLOCK IVA BY INCORPORATING LESSONS LEARNED FOR HIGH SPEED INTERCEPTOR AND MASS-FOCUSED WARHEAD, COMMON/SIMILAR SEEKER COMPONENTS, AND SHARED SUPPLIERS.







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**Air Force Perspective**  
**on**  
**Missile Defense**

Major General John Hawley  
Director, Global Power Programs  
Secretary of the Air Force (Acquisition)

10 April 1996

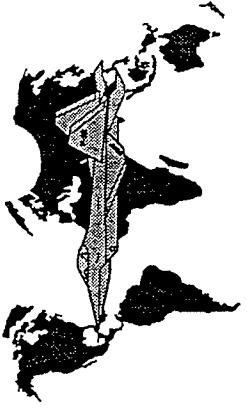
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# Outline



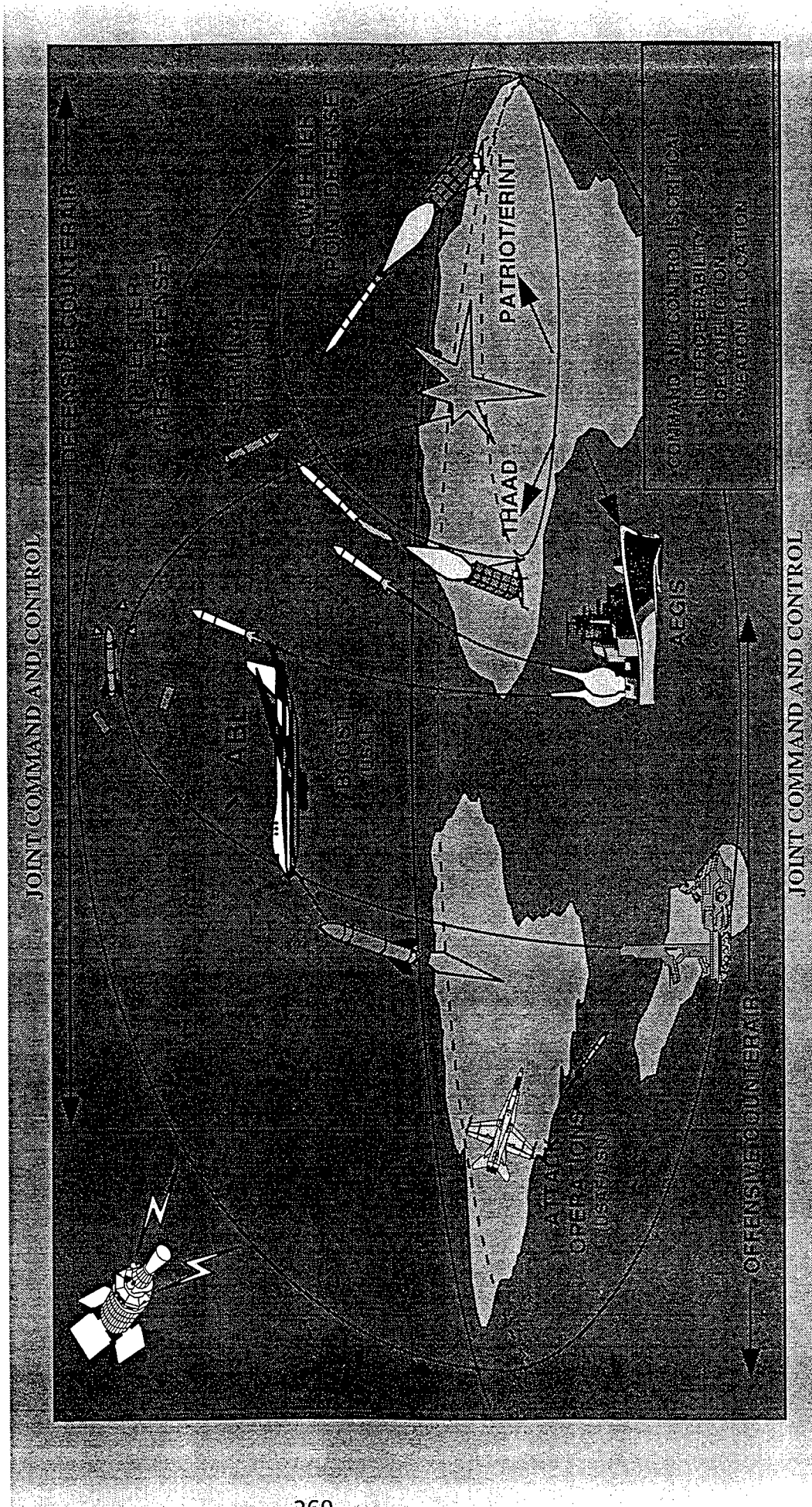
GLOBAL POWER

- Air Force View of Theater Missile Defense
  - Attack Operations
  - Boost Phase Intercept
  - BMC4I
  - Sensors
- National Missile Defense
  - BMDO Architecture
  - Air Force Near-term Alternative



# Joint Theater Air Defense

# GLOBAL POWER

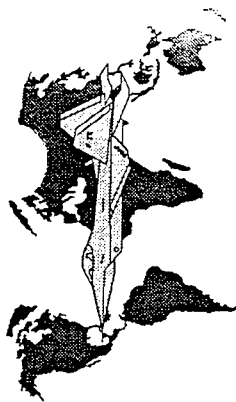






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# Theater Air Defense Concept

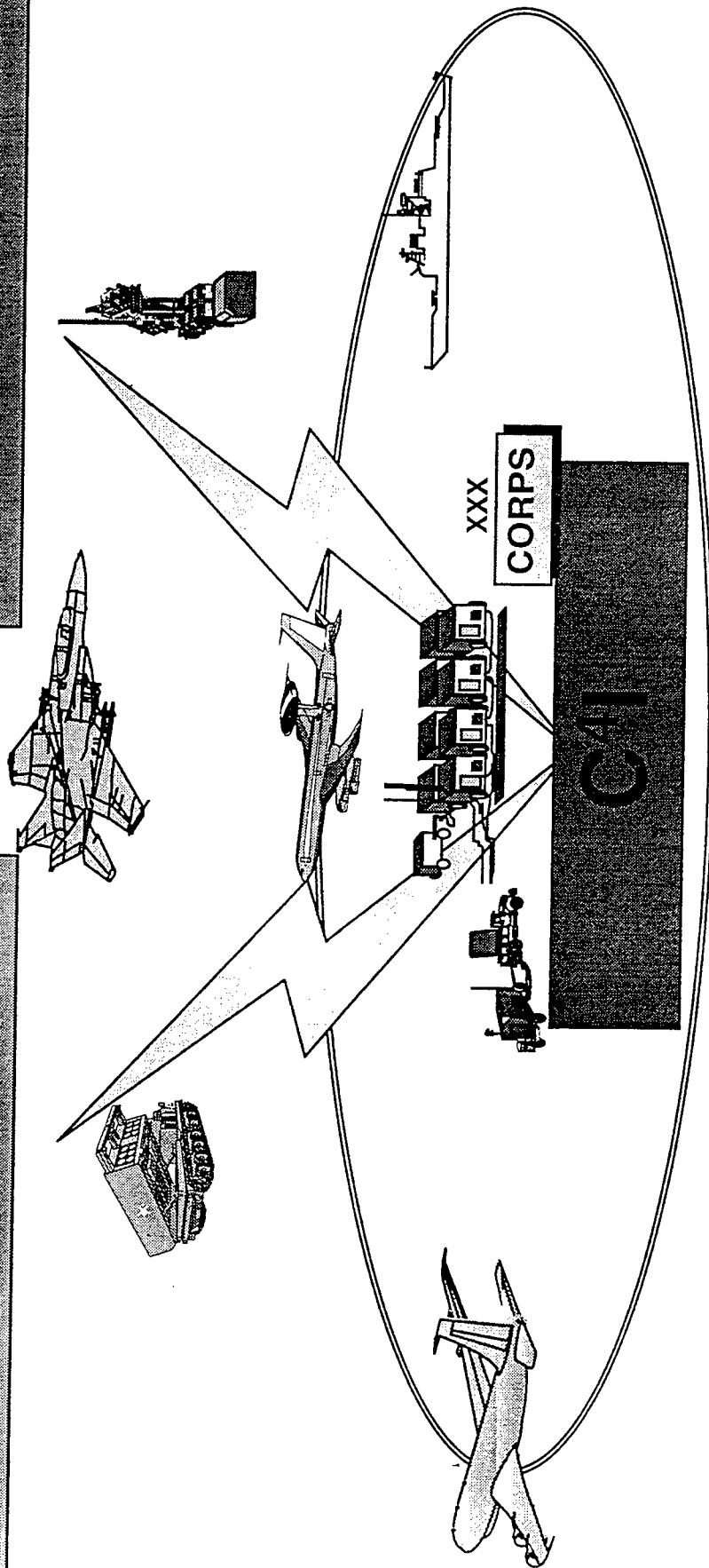


GLOBAL POWER

DESTROY as FAR FORWARD as possible!

**Offensive Counter Air  
Attack Operations**

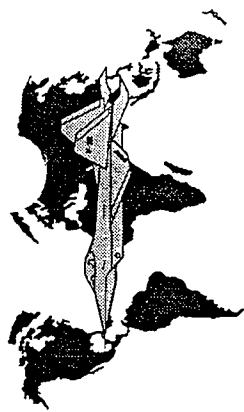
**Defensive Counter Air  
Active Defense**







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GLOBAL POWER

# Needed Improvements

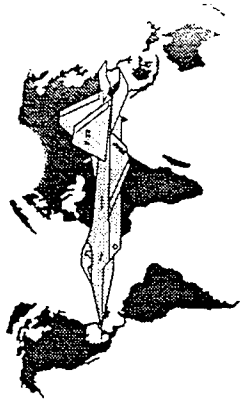
- Offensive Counter Air (Attack Operations)
  - Better target discrimination capability
  - C2 system with capability to rapidly direct forces against time critical targets (TCT)
- Defensive Counter Air (Active Defense)
  - Add Boost Phase Intercept Capability  
Airborne Laser (ABL)
  - Enhance cruise missile detection and track





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# Attack Operations Challenge



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**In Near Real, Real-time with HIGH confidence:**

## BMC<sup>4</sup>I Wide Area Search:

- Find all fleeting / critical mobile targets
- Identify and task attack assets

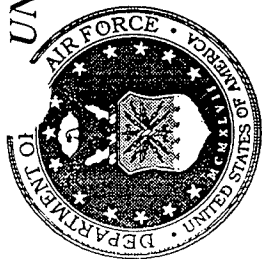
## BMC<sup>4</sup>I and Shooter:

### **Discriminate one target from the other**

- Overcome system and physical limitations to detection
- Beat enemy CCD
- Characterization of the target a critical data point

***Currently, high interest is TBM target set***

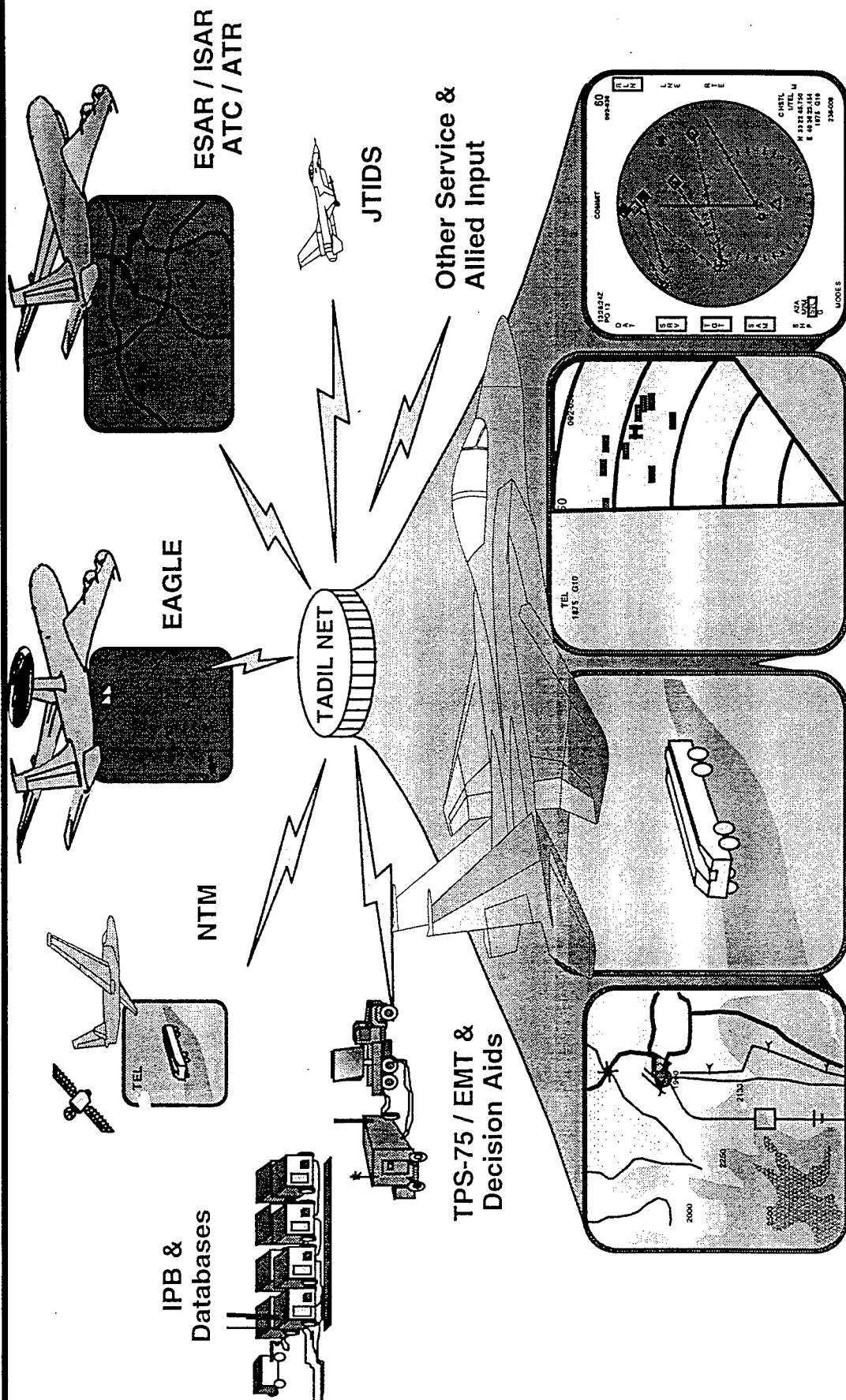




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# Improvements

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Real-Time Info to the Cockpit

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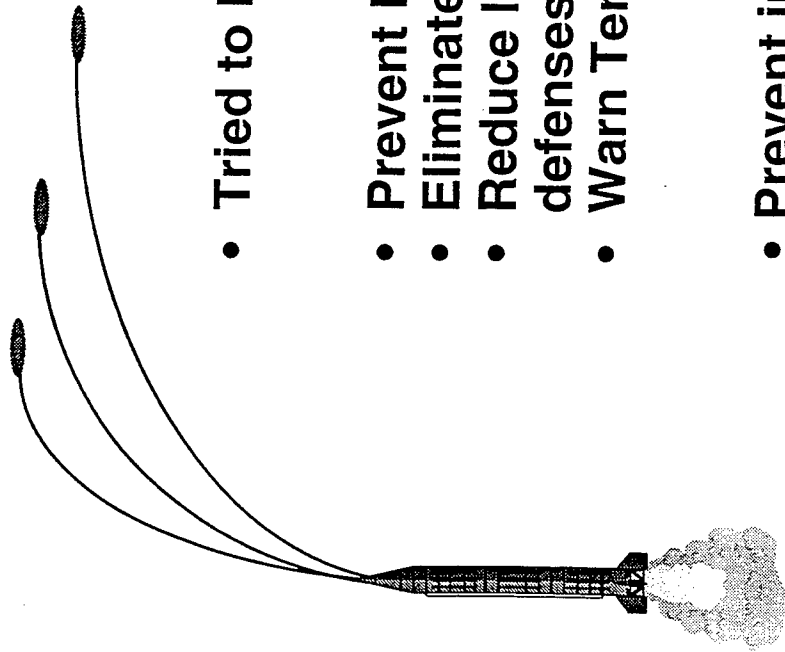




# Active Defense Challenge

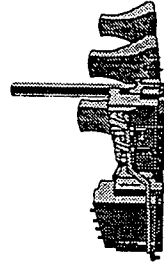
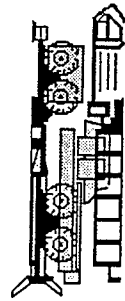


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- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• Tried to Prevent Launch!</li> <li>• Prevent Fractionation</li> <li>• Eliminate downrange impact of debris</li> <li>• Reduce leakage and stress on terminal defenses</li> <li>• Warn Terminal Defenses of launch</li> </ul> | <p><b>Attack<br/>Operations</b></p> <p><b>Boost<br/>Phase<br/>Intercepts</b></p> <p><b>Terminal<br/>Phase<br/>Intercepts</b></p> |
|---|--|

- Prevent impact on Friendly/Allied targets
- Damage limitation



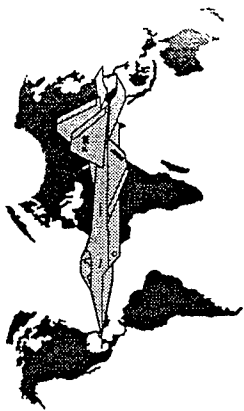
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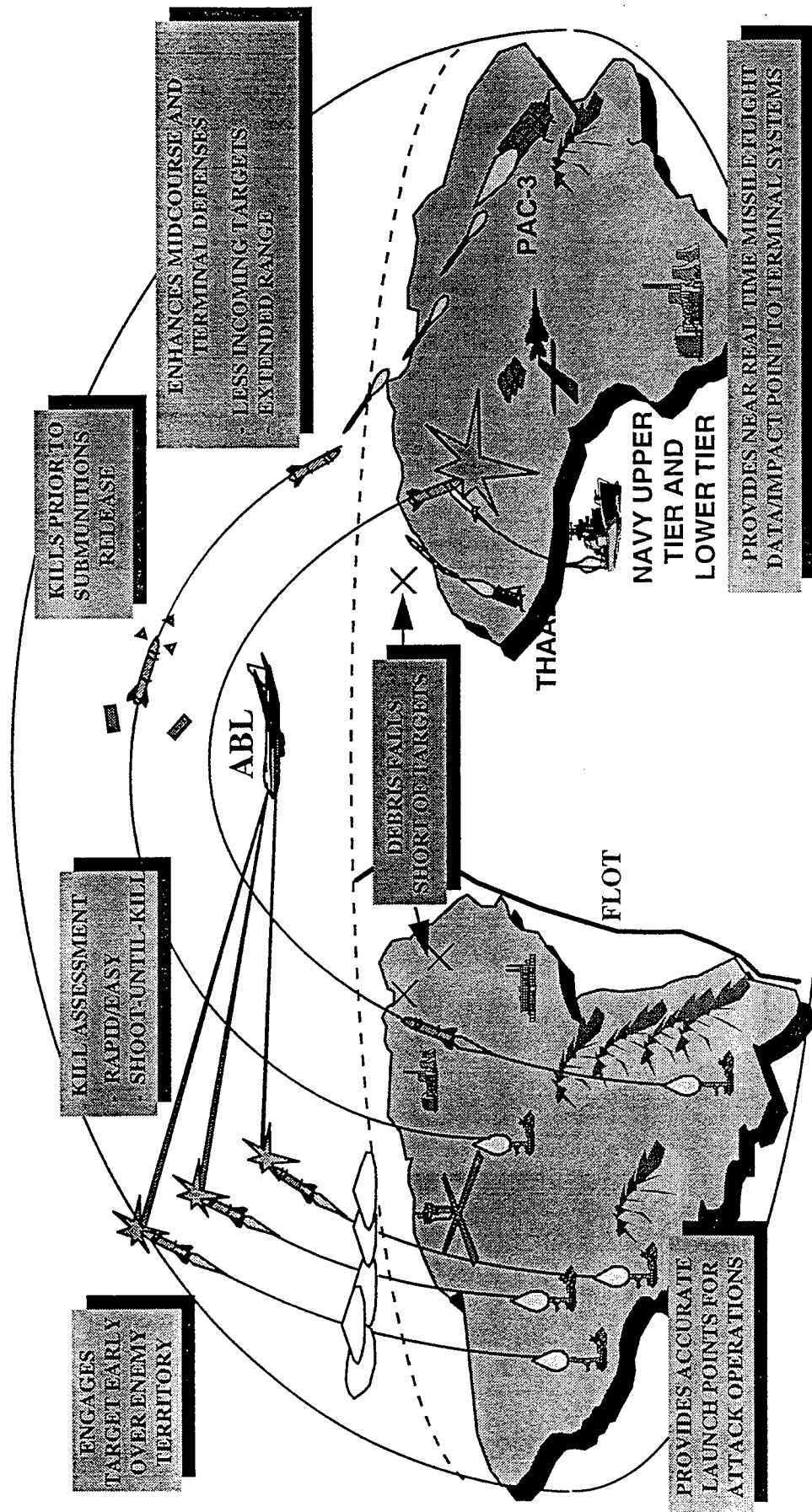


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# Why Boost Phase?



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*The only* Active Defense solution to counter Advanced Submunitions. Source: TMD COEA Executive Summary

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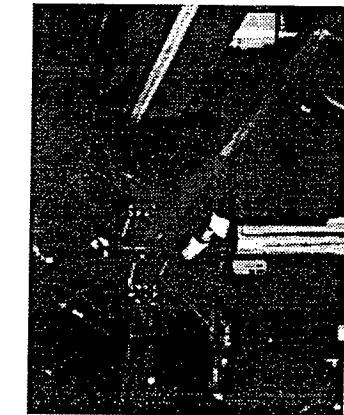
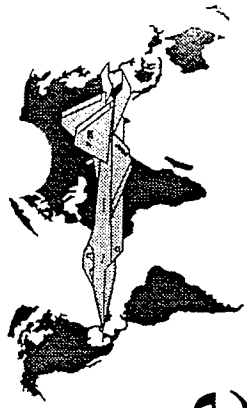


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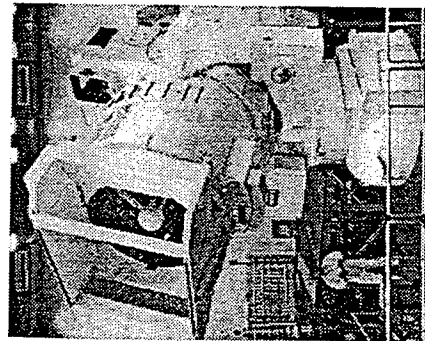


# ABL Appears Achievable

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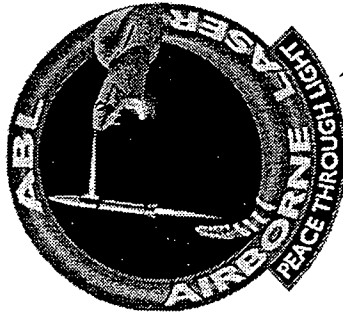
**HIGH ENERGY LASER**  
HIGH BRIGHTNESS LASER SCALING  
DEMONSTRATED  
CRITICAL LIGHTWEIGHTING TECHNOLOGIES  
DEMONSTRATED IN LABORATORY



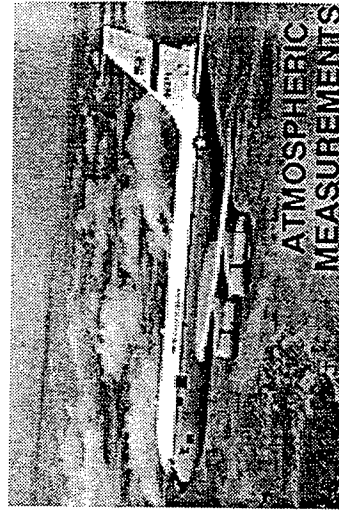
**HIGH ENERGY  
BEAM CONTROL / LASER  
INTEGRATION**  
NUMEROUS LETHALITY DEMONSTRATIONS  
AGAINST STATIC AND FLYING TARGETS



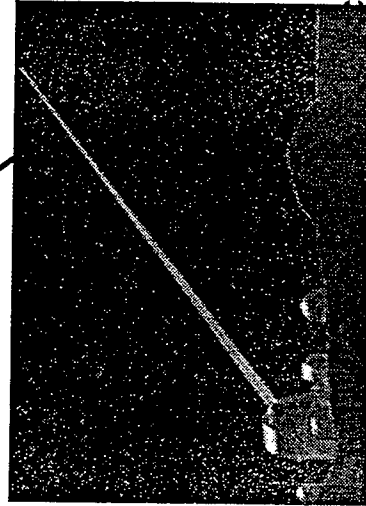
**AIRBORNE LASER INTEGRATION**  
DESTROYED: 5 AIR TO AIR MISSILES (AIM-9)  
1 CRUISE MISSILE (BQM-34)



**LETHALITY**  
DEMONSTRATED ABILITY TO KILL  
HARDEST TARGET ON THREAT  
LIST



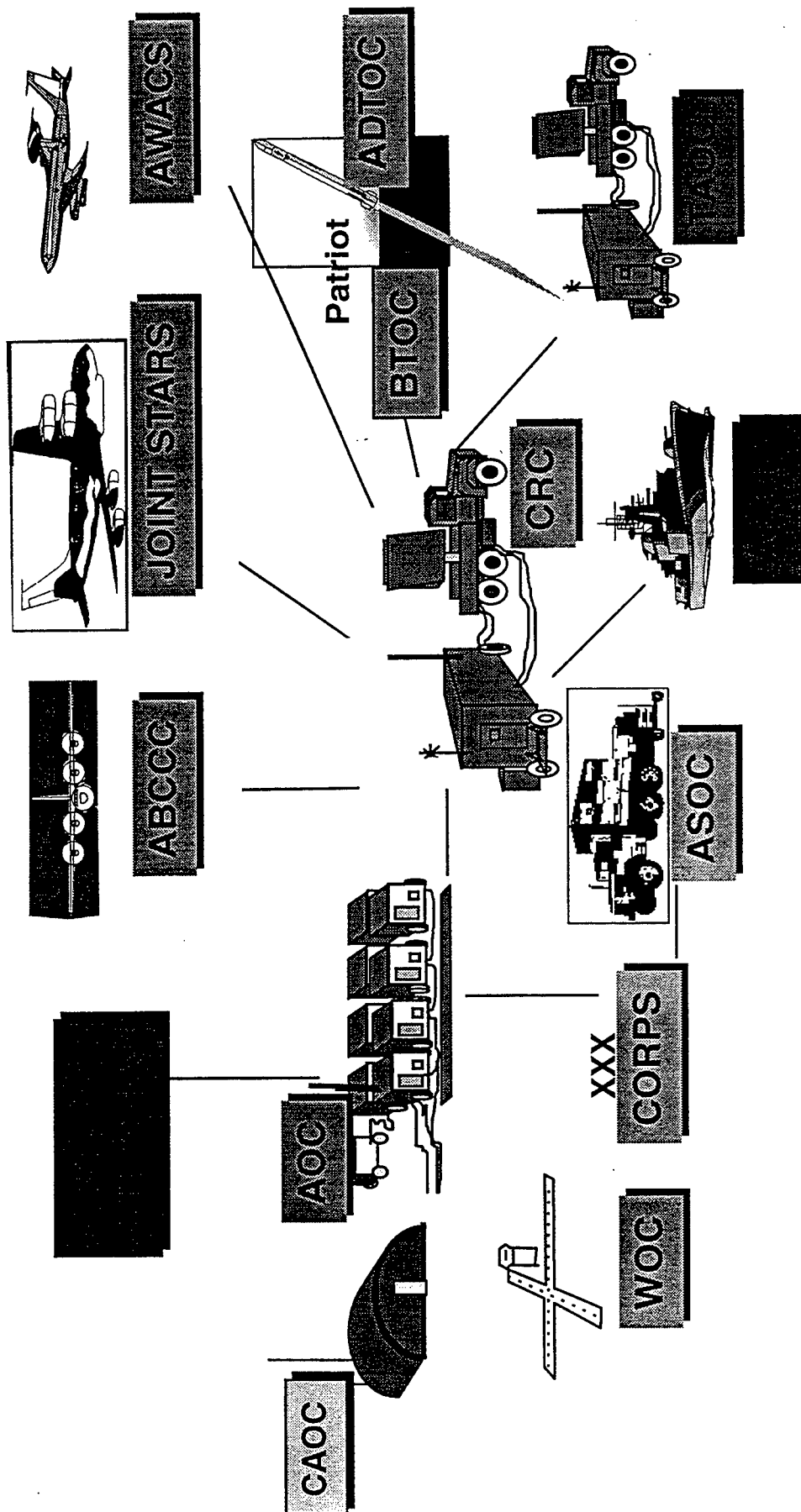
**ATMOSPHERIC  
MEASUREMENTS**  
EXISTING ATMOSPHERIC  
MODELS USABLE FOR ABL  
PROPAGATION



**EXISTING ADAPTIVE OPTICS  
HARDWARE EXCEEDS ABL  
REQUIREMENTS**

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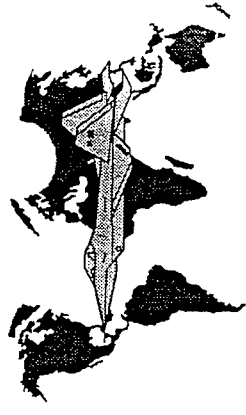




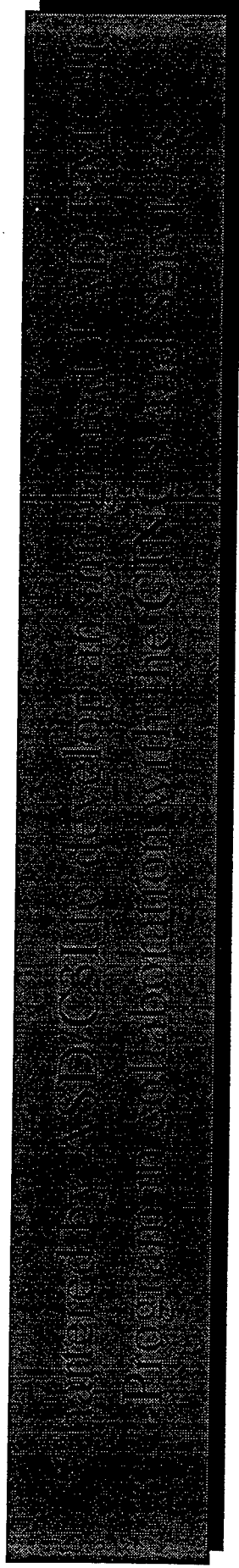


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# EXECUTIVE AGENT FOR TAD BMC4I MISSION AND OBJECTIVES



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## Overarching Architecture

278

Establish Joint TAD BMC4I functions, migration path and implementation roadmap

## Issues Resolution

- Incorporating Architecture Workshop and Joint Uniform Lessons Learned
- Staffing recommendations through Joint Oversight Committee and JROC

## Joint TAD Command and Control Plan

Develop CONOPS and document interoperability

## Validation Program

- Investigating how to leverage existing modeling and simulation resources
- Exercises and Wargames - demonstrate systems interoperability and overarching architecture principles

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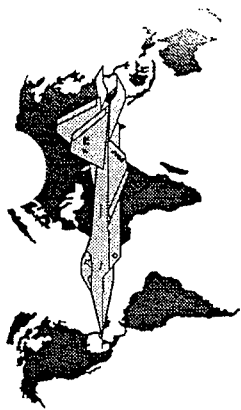
12





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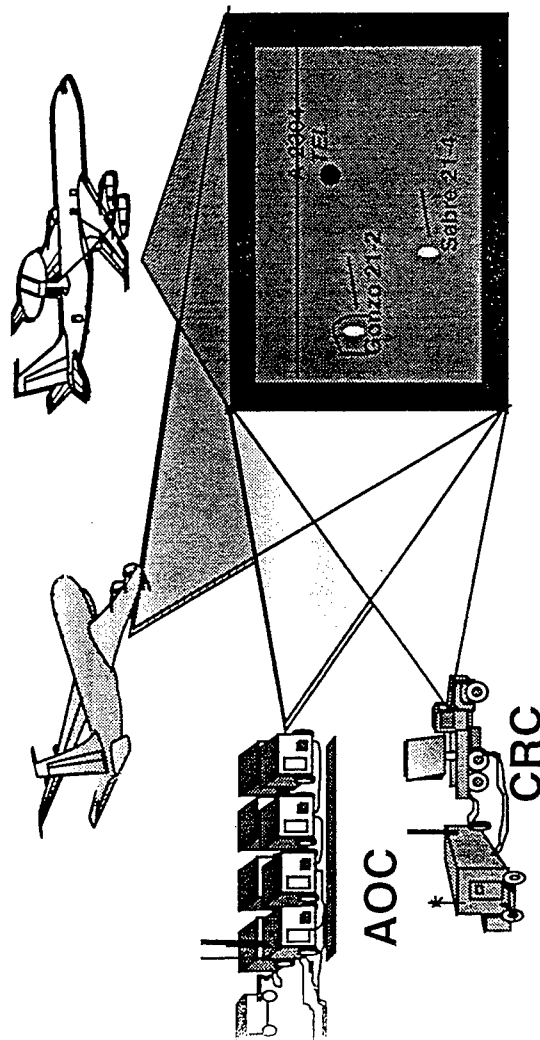
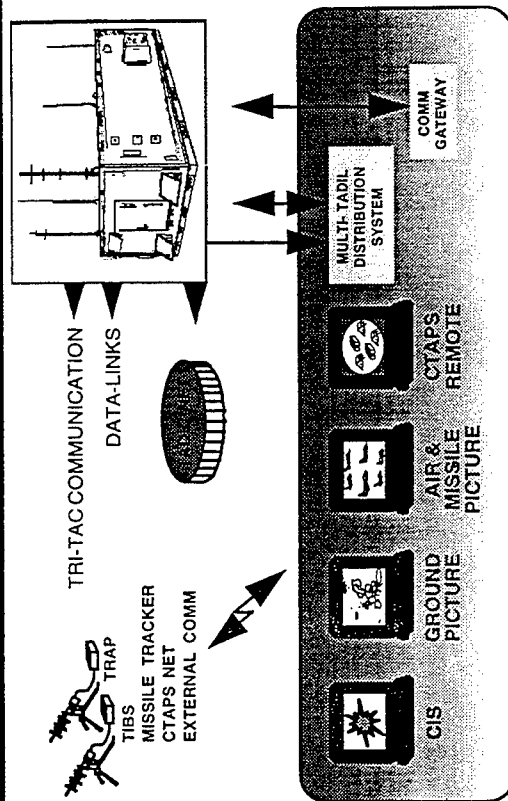
# TACS Enhancements



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## Near Term: Combat Integration Capability (CIC)

Merge surveillance  
& intelligence...at the AOC  
and CRC



## Far Term: Distributed Battle Management Environment

- Shared information in real- to near real-time
- Decision support
- Integrated displays
- Common battlespace view

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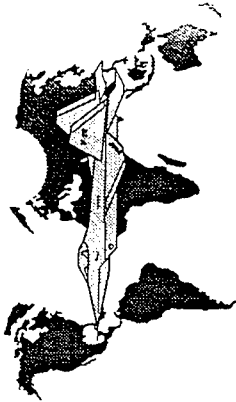
13



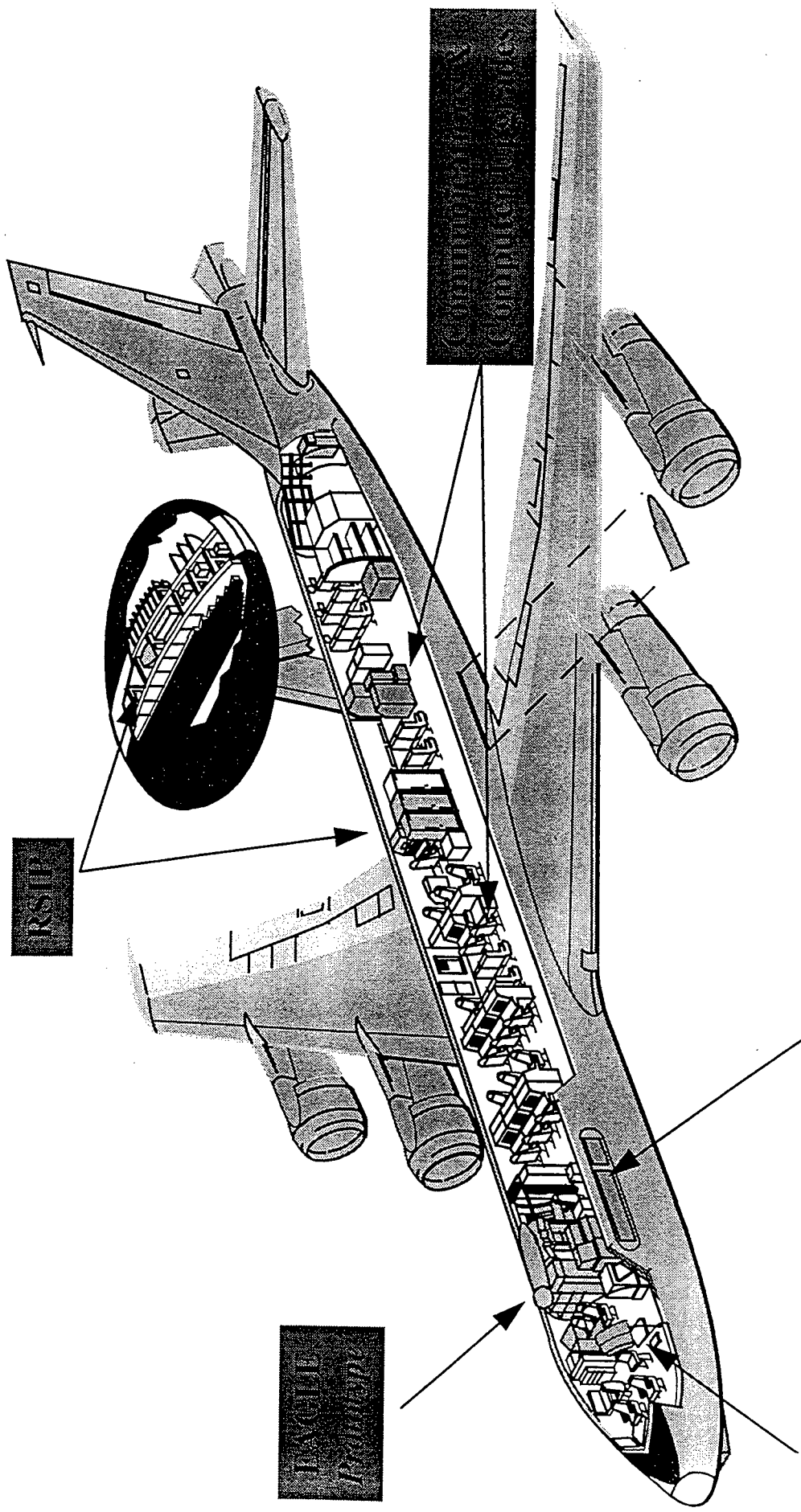


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# AWACS MODERNIZATION



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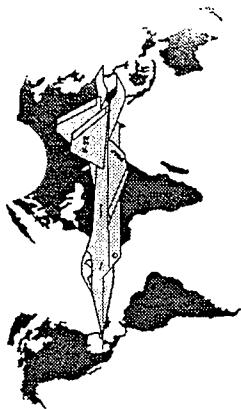






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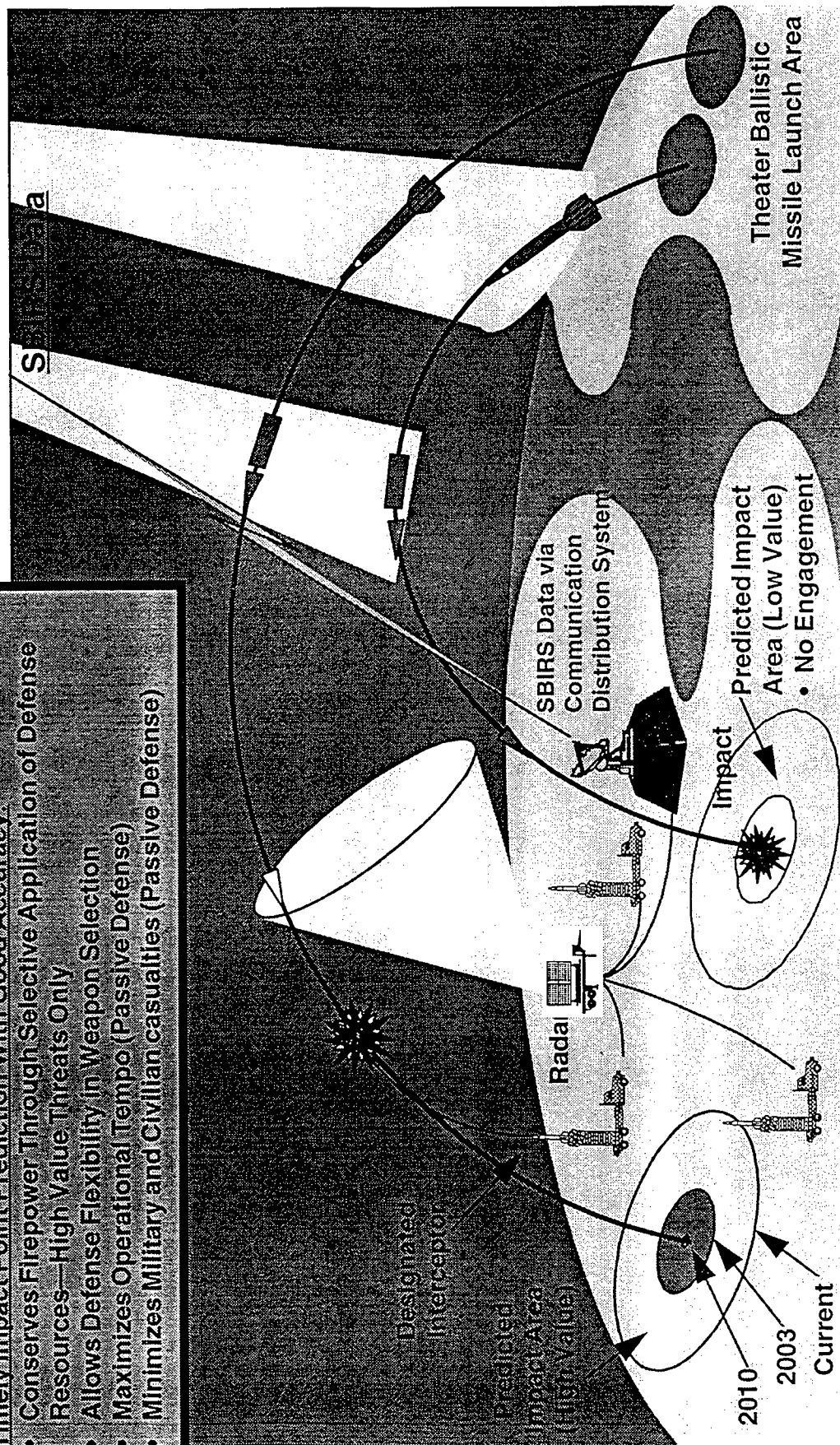
# Space Based Infrared System (SBIRS)



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## Timely Impact Prediction With Good Accuracy:

- Conserves Firepower Through Selective Application of Defense Resources—High Value Threats Only
- Allows Defense Flexibility in Weapon Selection
- Maximizes Operational Tempo (Passive Defense)
- Minimizes Military and Civilian casualties (Passive Defense)



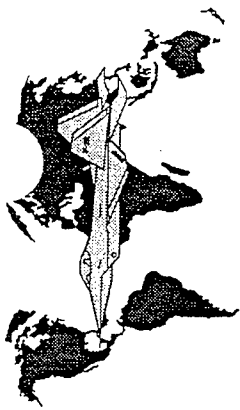
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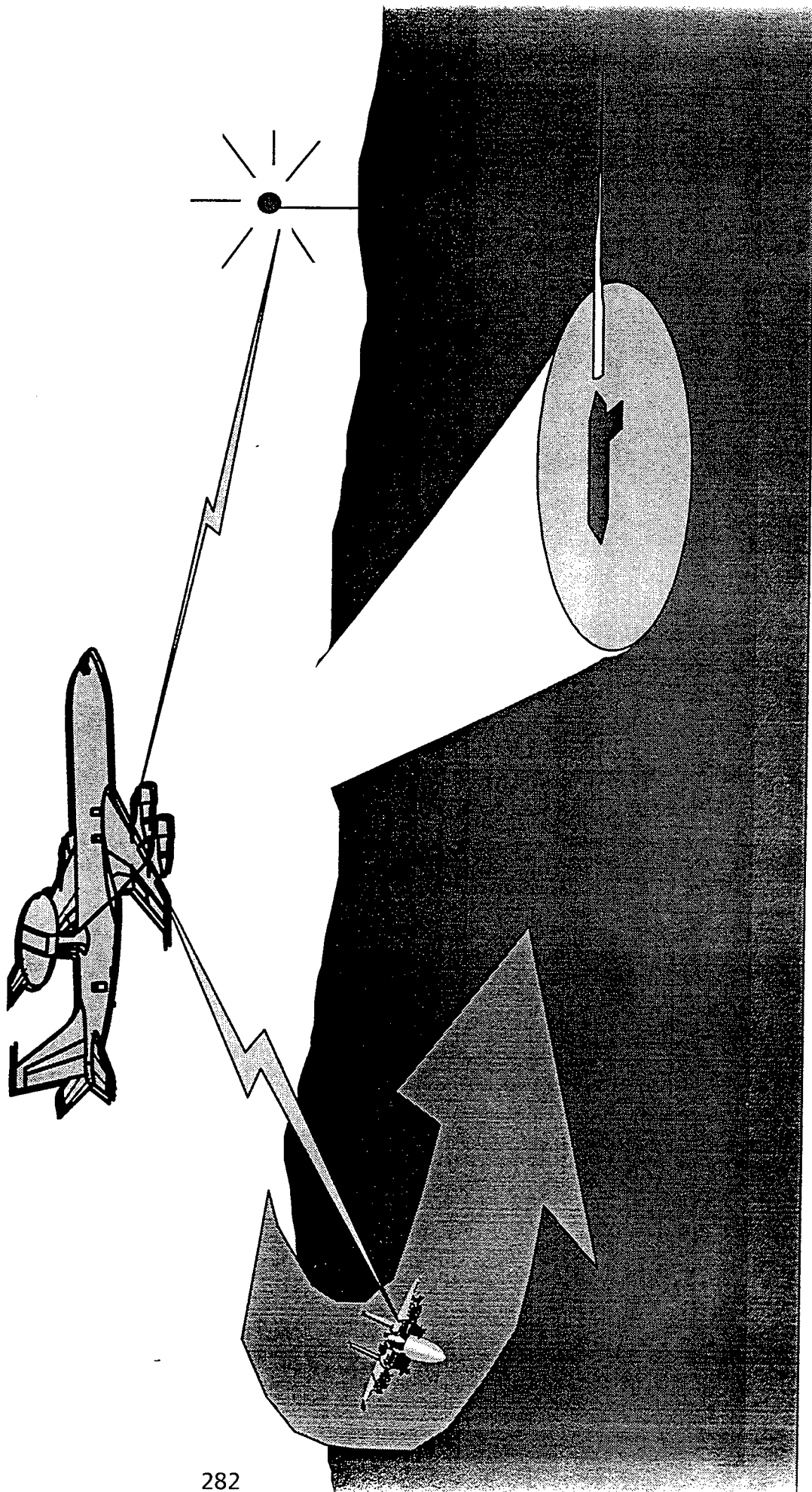
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# Low Signature Cruise Missiles



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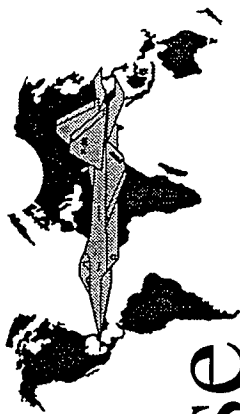


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# National Missile Defense

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## Air Force contribution to BMDO architecture

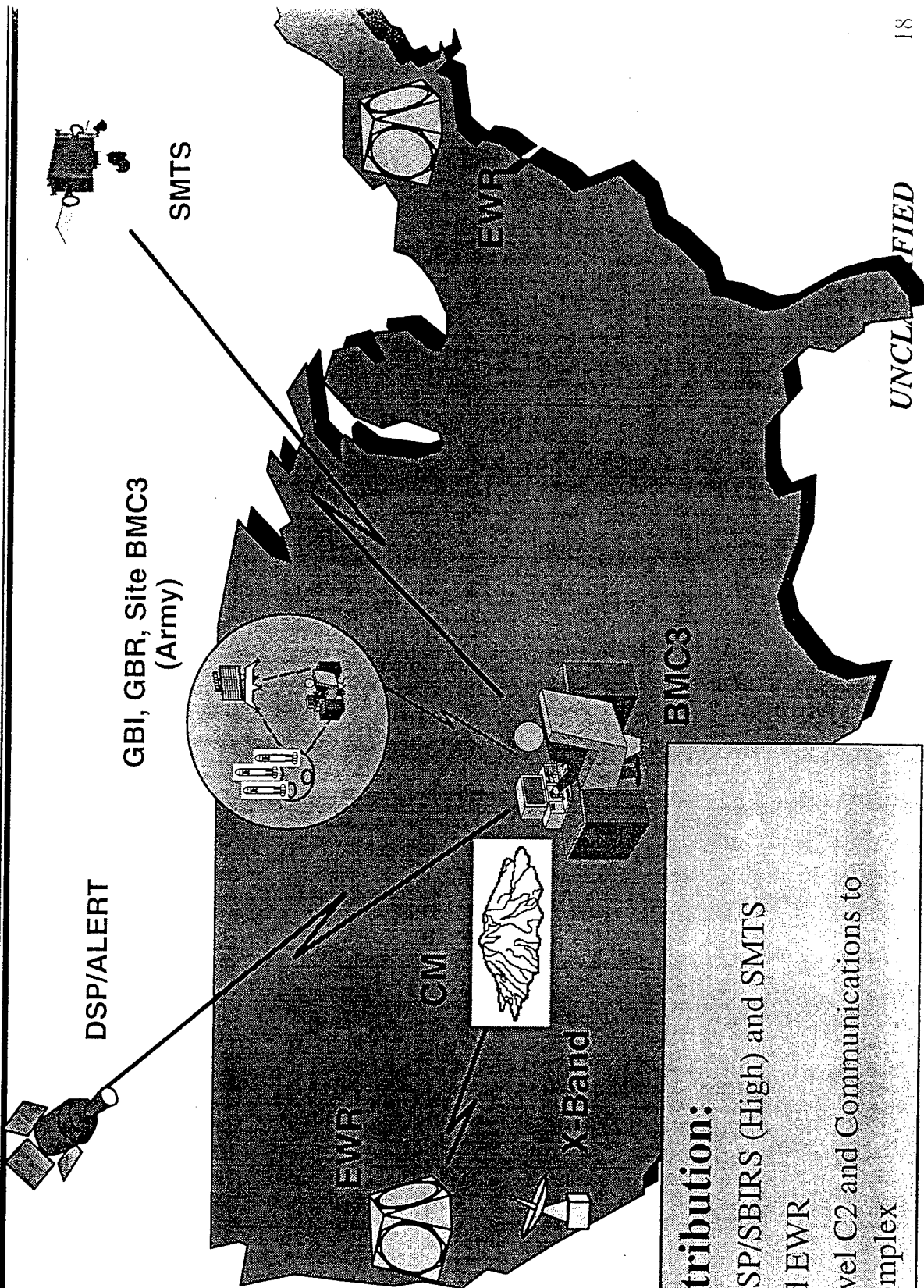




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# National Missile Defense

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## Air Force Contribution:

Space Sensors: DSP/SBIRS (High) and SMTS  
Radars: Upgraded EWR  
BMC3; CINCLC Level C2 and Communications to  
Cheyenne Mt.. complex





# BMDO NMD SBIRS




GLOBAL POWER

Single Site At Grand Forks, ND

- Ground Based Interceptors (GBI)
- Ground Based Radar (GBR)
- Brilliant Eyes (SMTS)

285



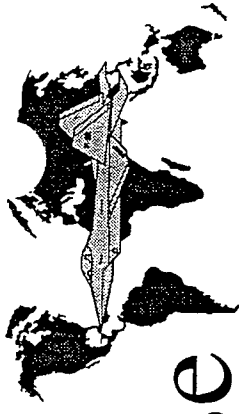
-  No Coverage
-  SMTS Cues Interceptor
-  SMTS Cues GBR





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# National Missile Defense



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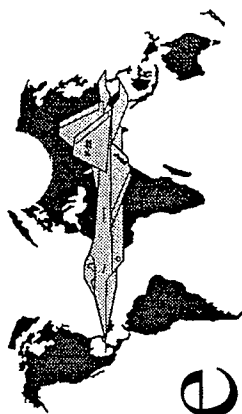
- *IF* Nation desires a NMD capability...
  - Near/mid-term capability
  - Ballistic missile defense against rogue nation threats
- *THEN*, Air Force has an option that
  - Provides single site coverage of North American and Hawaii
  - Achieves operational status within 4 years
  - Offers low cost (<\$2.5B), minimal program risk
  - Allows for growth
- *BY*:
  - Maximizing existing systems and infrastructure
  - Focusing on sensors and kill vehicle



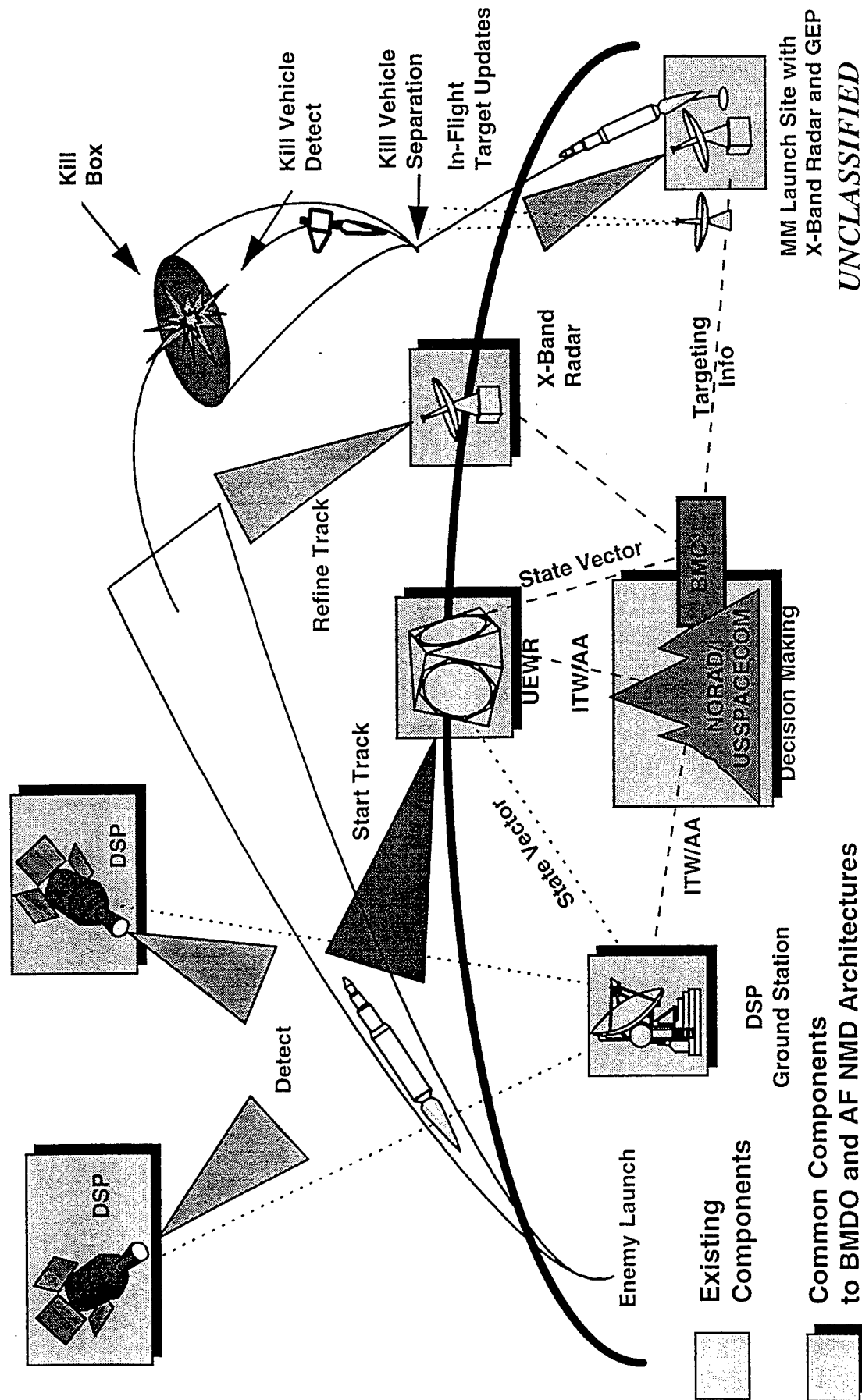


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# National Missile Defense



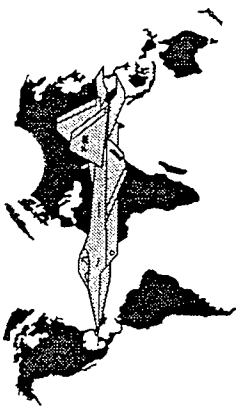
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# Conclusions

## *Theater Missile Defense*

- Essential to maintain momentum in all pillars
- Developing BMC4I improvements -- supports offensive and defensive counterair
- Airborne Laser provides an up-front shooter against ballistic missiles

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## *National Missile Defense*

- Air Force supporting BMDO architecture -- early warning radars, SBIRS, and BMC3
- Dictated by threat and national strategy

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22



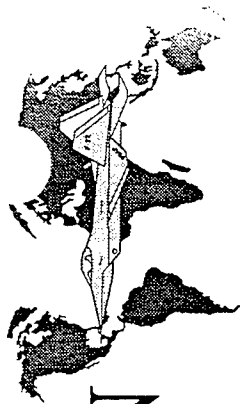
# BACKUP SLIDES



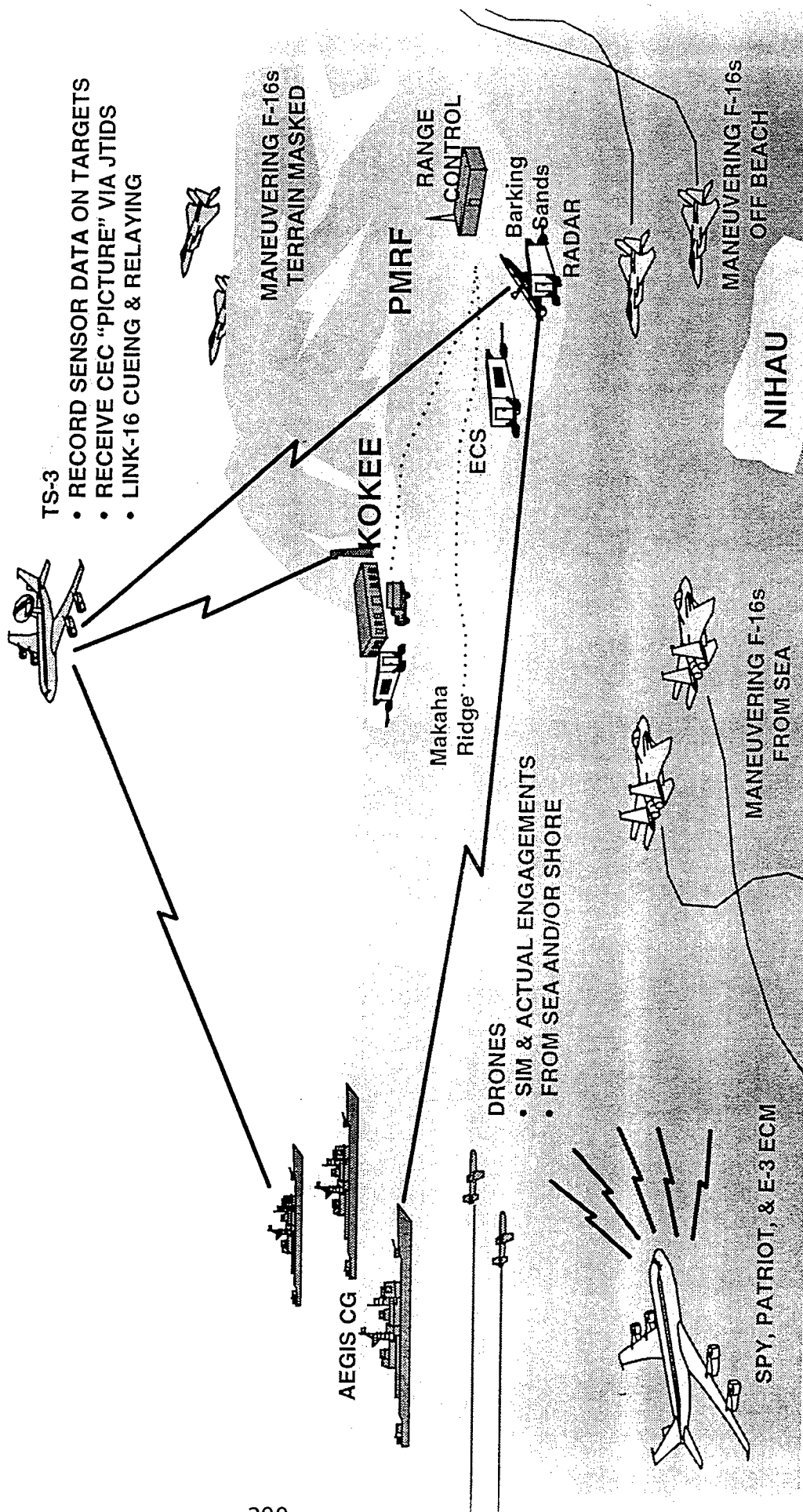


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# AWACS PARTICIPATION AT MOUNTAIN TOP



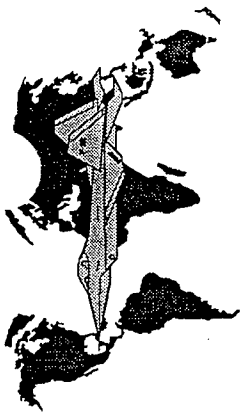
GLOBAL POWER







# TS-3 OPERATIONS MOUNTAIN TOP

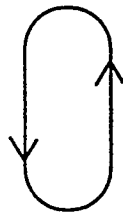


GLOBAL POWER

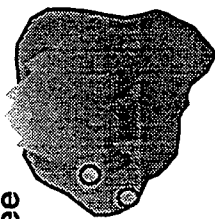
## COLLECTED:

- Radar, IFF, ESM sensor data
- Link-16 cueing & relay data
- CEC "picture" translated and transmitted via Link-16
- Composite picture
- JTIDS terminal activity
- Performance data for RSIP evaluation

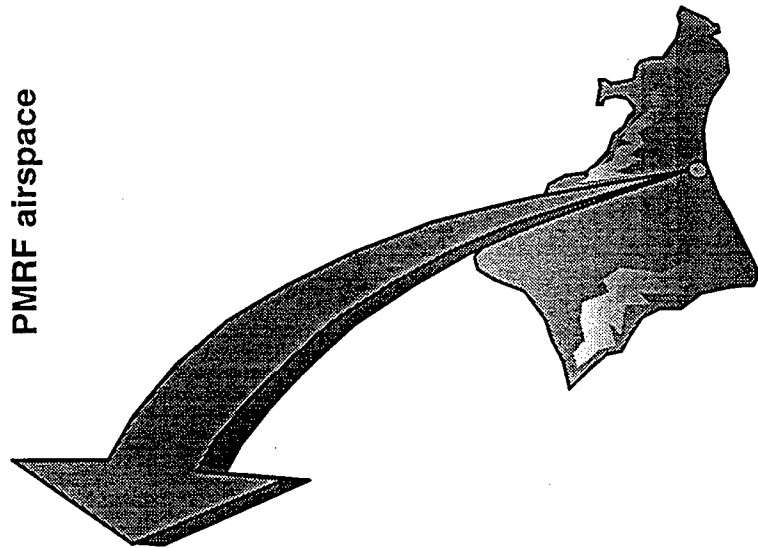
- Orbits limited to PMRF airspace



Kokee



Barking  
Sands



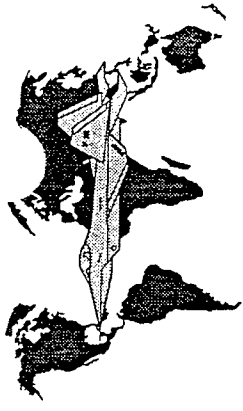
Hickam AFB





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# MOUNTAIN TOP EXERCISE



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## NAVY VIEW:

1. AEGIS/CEC Net Successfully Demonstrated In a Live-Fire Exercise
2. CEC Linked to PATRIOT Via Link-16
3. AEGIS/CEC Net Successfully Demonstrated Composite Tracking in TAD
4. Mt.. Top Demonstrates Essential Need for OTH CEC Equipped Capability

## AIR FORCE VIEW:

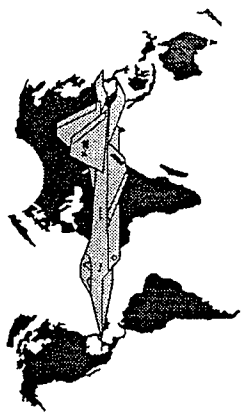
1. TS-3 Linked to AEGIS, PATRIOT, and Range With JTIDS/Link-16
2. TS-3 Provided OTH Cueing to Surface Radars
3. TS-3 Successfully Linked Tactical Scene With CEC/JTIDS Gateway
4. TS-3 Operating Orbit Unrealistically Positioned





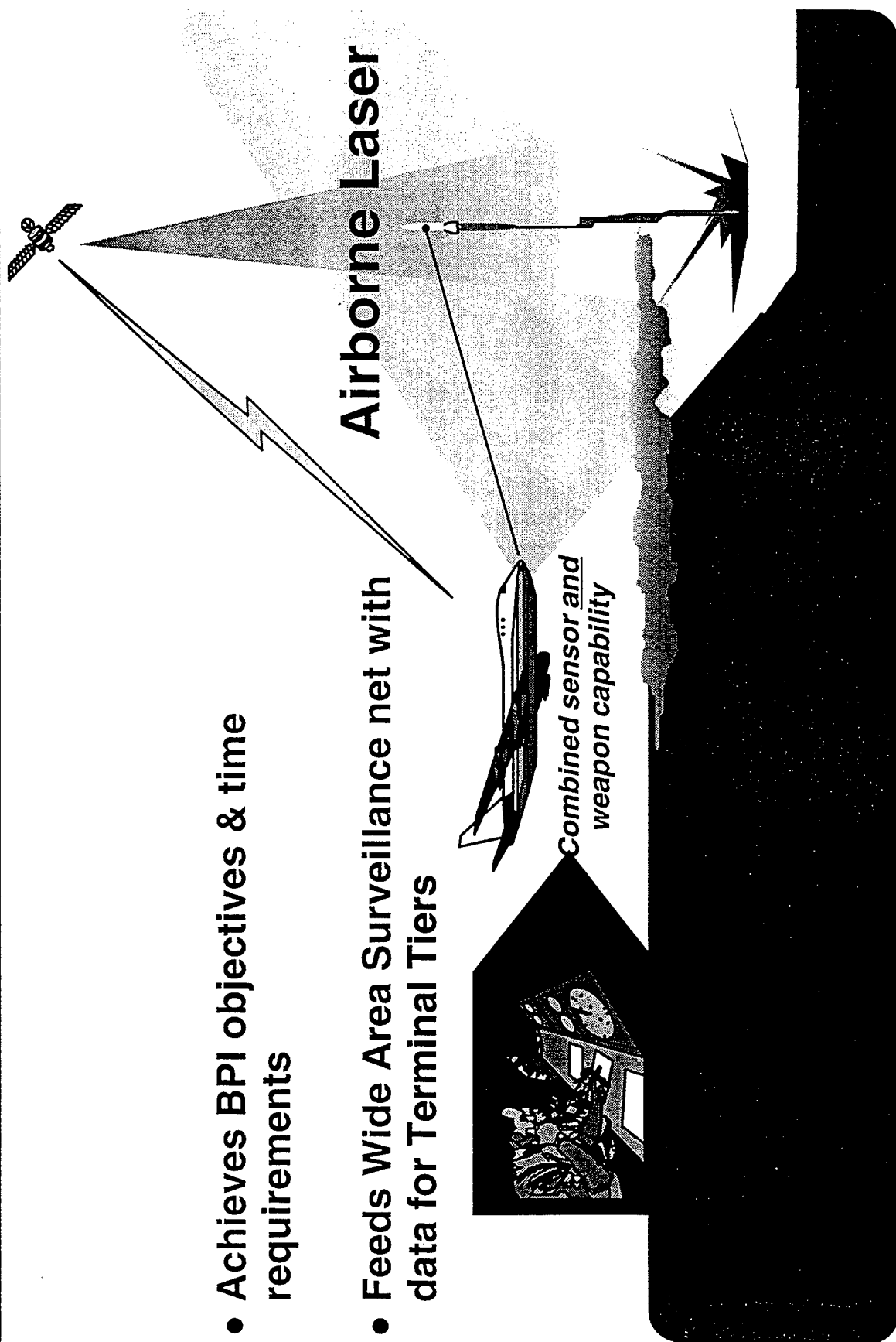
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# Boost Phase Intercept



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- Achieves BPI objectives & time requirements
- Feeds Wide Area Surveillance net with data for Terminal Tiers







# SBIRS

## Accurate Launch Point Determination Supports Attack Operations

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### SBIRS

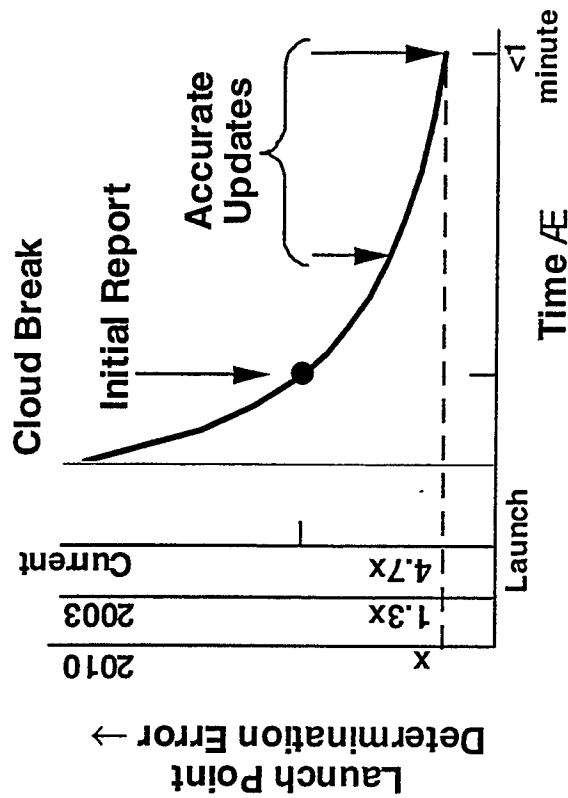
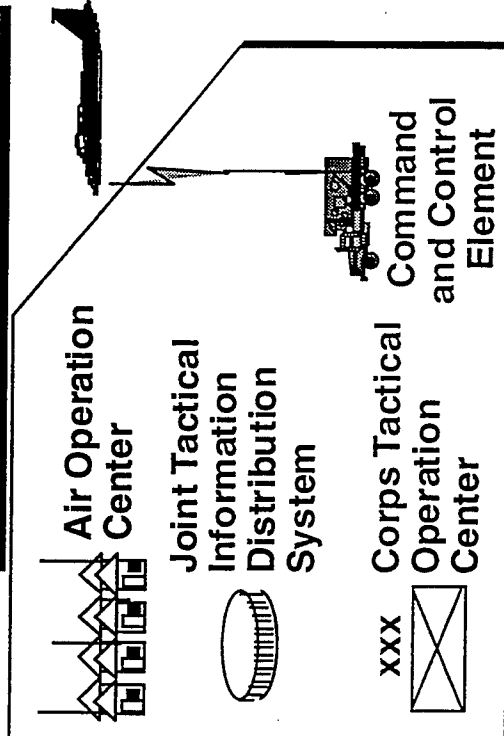
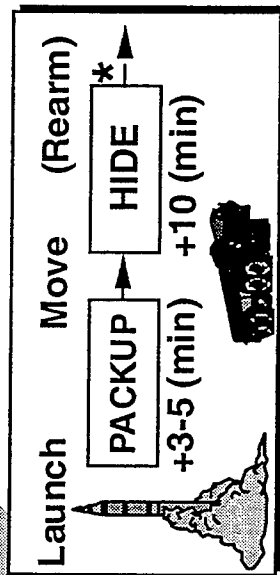
- Launch Area Surveillance
- Detection/Track/Report



- Timely Reporting



Evolved  
Joint Tactical  
Ground Station



- Launch Point Determination Provided Direct to Theater
- Results in
- Disruption in Offense Battle Plan
- Fewer Threats Launched Due to Transporter/Erector Launcher Attrition

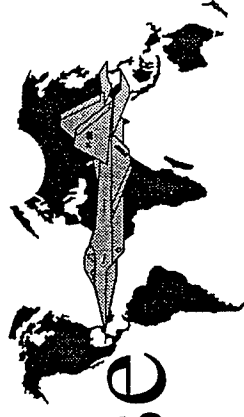




UNCLASSIFIED

# National Missile Defense

## Arms Control



GLOBAL POWER

- There are ABM Treaty issues with any NMD proposal, not just MM BMDO and AF position that MM-based NMD is not a START violation  
Defensive MM would be START counters, but would not violate treaty
- Per BMDO request, AF developed treaty compliant path to MM NMD  
DoD Compliance Review Group (CRG) makes final ruling
- Arms control is an issue, but not necessarily a show-stopper
- Powerful stability signal...deploying defenses at expense of offense



